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LAND SERVICE.

1923.

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THE WAR OFFICE,
November, 1923.

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OF THE
9.2-IN. B.L. GUNS,
MARK IX, "C" MARK IX and MARKS X,
X^v and X*,
ON
CARRIAGES, GARRISON, BARBETTE,
MARKS IV, V, V_A, V_B, VI and VI_A.
LAND SERVICE.

1923.

By Command of the Army Council,

THE WAR OFFICE,
November, 1923.

H. J. Creed



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NOTE.—This book has been corrected up to November, 1922. Any alterations which may be suggested should be forwarded to the Chief Inspector, Royal Arsenal, Woolwich.

ORDNANCE, B.L. 9.2-INCH.

MARK IX, "C" MARK IX AND MARKS X, X* AND X*.

PARTICULARS.

	Marks IX and "C" Mark IX.	Marks X, X* and X*.
Material	Steel (wire construction).	Steel (wire construction).
Length, total	445.25-inches.	442.35-inches.
Position of centre of gravity without breech mechanism	157.6-inches from face of breech.	164.5-inches from face of breech.
Weight—		
With breech fittings, nominal	27-tons.	28-tons.
Without breech fittings	26-tons 8-cwt. 1-qr.	27-tons 19-cwt. 0-qr.
Preponderance	Nil.†	Nil.
Bore—		
Calibre	9.2-inches.	9.2-inches.
Length	430.0-inches.	429.33-inches.
Capacity	32,470-cubic inches.	32,900-cubic inches.
Chamber—		
Diameter—		
Largest	13-inches.	13-inches.
Smallest	9.8-inches.	10.2-inches.
Length	71.215-inches.	71.0-inches.
Capacity	8,123-cubic inches.	8,123-cubic inches.
‡ Rifling—		
Length	354.435-inches.	353.8-inches.
Marks I and I*—		
System	Polygroove, plain section.	Polygroove, modified plain section.
Twist	Straight from breech end of rifling to 303.585-inches from the muzzle, the remaining 303.585-inches, increasing from 0 to 1 turn in 30 calibres at the muzzle.	
Grooves, number	37.	
Mark I—		
Grooves—		
Depth	Straight .08-inch.	
Width	Twist .06-inch.	
Mark I*—		
Grooves—		
Depth ... ..	.08-inch throughout.	
Width ... ..	.65-inch throughout.	
Mark II—		
System	Polygroove, plain section.	
Twist	Uniform 1 turn in 30 calibres.	
Grooves—		
Number	46.	
Depth ... ..	.07-inch.	
Width ... ..	.4188-inch.	
Means of rotation	Driving band.	
Firing mechanism	Electric and percussion.	
System of obturation	Pad (slow-coned). | Pad (steep-coned).	

† Nos. 134, 135 and 140 guns have breech preponderance, all others have a counterpoise at the muzzle; in some cases this is shrunk and screwed on, in other cases it is formed solid with the "A" tube in manufacture.

‡ Mark I rifling will be modified to Mark I* as opportunity offers. Mark II rifling is for guns of future manufacture and existing guns when relined on repair.

GUN BODY, MARK IX.

(Plate I.)

The gun body is constructed of steel and consists of an A tube with an inner A tube extending from the seat of the obturator to the muzzle. The inner A tube is secured longitudinally to the A tube by means of corresponding shoulders and a steel breech bush which is screwed into the A tube at the rear; the breech bush is also prepared for the reception of the breech screw. Successive layers of flat steel wire are wound round a portion of the A tube, the ends being secured to steel rings provided for the purpose. The B tube is shrunk round the A tube immediately in front of the wire, extending to the muzzle. Fitted over the exterior of the wire and overlapping a portion of the B tube is a jacket secured longitudinally by means of corresponding shoulders on the B tube and a screwed steel bush at the rear. A trunnion ring is screwed over a portion of the exterior of the jacket.

The central portion of the chamber is cylindrical, with curved slope in front and coned rear.

In future manufacture the front end will be coned to facilitate the ramming home of the projectile. This will also apply to existing guns when passing through Ordnance factories for repair.

The exterior of the jacket is prepared with seatings for the reception of the sighting and elevating band. Two metal brackets are fixed to the trunnion ring for the foresights and two steel brackets for securing the tangent sight clamps when in position on the gun, are fitted to the sight ring.

A plane for clinometer is prepared on the upper surface of the jacket at the breech.

Axis lines .05-inch deep are cut on the horizontal axis at the breech and muzzle ends on the right side. Fine horizontal and vertical axis lines are also cut on the breech and muzzle faces.

The actual weight of the gun is engraved on the top of the jacket at the breech and the Royal monogram on the chase.

The nature, Mark, registered number, manufacturers' initials and year of manufacture are engraved on the upper portion of the breech face.

GUN BODY "C" MARK IX.

The gun body is of the same construction as *Mark IX*, from which it differs in having the trunnions reduced in length and shaped to suit the attachments of *Marks V_A and V_B* barbette carriages.

A steel counterweight, in halves, is secured by two steel bands and securing bolts round the breech end of the gun, when the latter is mounted in *Mark V_A* carriage, in order to balance muzzle preponderance. The counterweight is not required on the gun when mounted in *Mark V_B* carriage.

GUN BODY, MARK X.

(Plate I.)

The gun body is constructed of steel and consists of A and B tubes, a series of layers of steel wire and jacket. In the interior of the A

tube is an inner A tube, secured longitudinally by means of corresponding shoulders and a steel breech bush, which is screwed into the A tube at the rear; the breech bush is also prepared for the reception of the breech screw. Successive layers of flat steel wire are wound round the A tube, the ends being secured to steel rings provided for the purpose. The B tube is fitted over the exterior of the wire, extending over nearly half the length of the gun from the muzzle. The jacket is fitted over the exterior of the wire in rear and a portion of the B tube and is secured longitudinally by corresponding shoulders on the B tube and by a screwed steel collar over the A tube at the rear. The gun is without trunnions. Two projections round the jacket near the breech and a key form a seating for the rear band connecting the gun to the mounting. The key is on the under surface of the jacket and is formed when milling to shape the front projection.

The central portion of the chamber is cylindrical, reduced in diameter, with curved slope in front and coned at the rear. In future manufacture, the front end will be coned to facilitate the ramming home of the projectile. This will also apply to existing guns when passing through Ordnance factories for repair.

A plane for clinometer was originally prepared on the upper surface of the jacket at the rear, but is now cut in front of the swell on the jacket.

Sighting lines are formed on the horizontal axis of the gun at the breech and on the horizontal and vertical axis at the muzzle, and in future manufacture axis lines will be cut on the breech end.

The actual weight of the gun is engraved on the top of the jacket at the breech and the Royal monogram on the chase.

The nature, Mark, registered number, manufacturers' initials and year of manufacture are engraved on the upper portion of the breech face.

GUN BODY, MARK X^v.

(Plate I.)

There are only two guns of this description in the Service. The gun body differs from *Mark X* in the construction and consists of an A tube with an inner A tube, both extending the whole length of the bore, the A tube forming the chase. Layers of flat wire over the A tube extend from the breech to a little more than half the length of the gun. Over the exterior of the wire is the jacket, secured longitudinally by corresponding shoulders on the A tube and a screwed steel collar over the A tube at the rear.

GUN BODY, MARK X^{*}.

The gun body differs from *Mark X* principally in having a taper inner A tube, which is secured longitudinally by the breech bush and by five corresponding shoulders immediately in front of the chamber, the remainder of the tube, along the chase, tapering towards the muzzle.

BREECH MECHANISM.

MARK IX GUN.

(Plate II.)

The guns are fitted with a continuous motion breech mechanism. The mechanism is so arranged that, by revolving the worm-spindle lever in one direction, the breech screw is automatically unlocked and swung into the loading position. After loading the same lever is revolved in the opposite direction and inserts the breech screw and turns it into the locked position. At the same time the electric contact bolt is withdrawn from the electric lock for electric firing, and the striker of the percussion lock is retained in a position of safety by the safety plunger for percussion firing, until the breech screw is securely locked in the gun.

The names of the principal parts of the breech mechanism are shown on *Plate II*.

DESCRIPTION OF BREECH MECHANISM.

Breech screw.—The breech is closed by a steel parallel screw, having six portions of the screw thread removed longitudinally, so as to admit of the breech being closed (when the breech screw is pushed home) by the twelfth of a turn.

A bronze end plate with steel roller path, for partially revolving the breech screw, is secured to the rear face by fixing screws. A steel rack for withdrawing the screw is provided on the right side. A cam lever, with hinge bolt and set screw, is provided for use with the breech screw if found necessary. The recess in the end plate for the cam lever is fitted with a preserving block when the cam lever is not in use.

The interior of the breech screw is recessed for the reception of the axial vent.

Obturator pad and discs.—Obturation is obtained by means of a mushroom-headed axial vent of steel passing through the centre of the breech screw with a pad and a pair of metal discs. The inner face of the breech screw is flat and between it and the head of the vent the pad and discs are arranged. The pad is made of asbestos worked up with mutton suet to a proper consistency and enclosed in a strong canvas cover; it is reduced to shape and pressed in a hydraulic machine. The pad is enclosed between two protecting discs.

The front and rear protecting discs are of tin, each having a steel ring round the outer circumference. The rear disc is also bushed with a ring of manganese bronze.

If correctly assembled, the whole should fit together compactly.

Thin steel adjusting discs are provided for insertion behind the rear protecting disc when found necessary.

Action.—When the breech screw is pushed into the gun, the pad and discs enter the chamber with ease. On turning the breech screw, the obturator pad is pressed home into the coned seating in the gun by the travel of the screw. The bore is thus closed by the pad which is in contact with the bore all round the circumference, while the mushroom head of the vent receives the force of the gas on discharge.

On firing the gun, the pressure acts on the mushroom head of the vent and compresses the pad against the breech screw, thus causing it to expand. This expansion is radial to the axis and equal in every direction and is sufficient to prevent the escape of gas. On the pressure being removed, elasticity comes into play and the pad and discs can be withdrawn from the coned seating so soon as the screw is unlocked.

Axial vent.—The axial vent consists of a mushroom-headed steel bolt, with a fire channel through its longer axis, enlarged at the rear end to form a tube chamber. Externally, it is provided with screw threads to engage those of the vent nut and thrust collars for the attachment of the slide box. The spiral spring, washer and nut are placed upon the vent in the order named.

Carrier ring.—The carrier ring, for supporting the screw when withdrawn, is of bronze and is hinged by a bolt to the breech mechanism frame on the right side. The hinge joint is provided with a roller frame with eight coned rollers and two bearing plates. To the lower end of the hinge bolt is secured a worm-wheel, which engages with a worm and worm-spindle fitted to the lower part of the breech mechanism frame. The hinge bolt is also fitted with a bevel wheel and rack pinion, the former engaging with a bevel wheel with friction roller on the carrier ring and the latter with the rack on the breech screw, in such a manner that, when the hinge bolt is revolved in one direction the friction roller engages the roller path in the breech screw end plate and turns the screw into the unlocked position; the rack pinion then engages with the rack on the breech screw and withdraws the latter, the whole being then swung round into the loading position. The reverse action takes place when the hinge bolt is revolved in the opposite direction.

A catch with spiral spring is provided in the left side of the ring and engages a socket on the breech mechanism frame when the breech is closed. The catch is automatically released by the first movement of the breech screw in opening the breech.

A "Lever, worm-spindle, heavy," is provided on the outer end of the worm-spindle, by means of which the latter is revolved in the required direction when working the breech.

Breech mechanism frame.—The frame is of bronze and is attached to the breech face of the gun by fixing screws. Two lugs for supporting the hinge joint of the carrier ring are provided on the rear face at the right and a bracket for worm-spindle on the lower side. A hinged catch for retaining the carrier ring in the open position is attached to the worm-spindle bracket and engages the ratchet wheel on the worm-spindle. A steel socket for the reception of the catch carrier ring is provided on the left side of the frame.

FIRING MECHANISM.

MARK IX GUN.

(Plate III.)

The firing mechanism is designed for percussion firing and for electric firing with wireless tubes and is so arranged that the gun cannot be fired before the breech is fully closed.

Box, Slide.

The slide box, in which the percussion lock and the electric lock slide, is of steel in two parts and is secured to the outer end of the axial vent by thrust collars.

Lock, Electric.

The following are the principal parts of the lock :—

Lock frame with flat spring, firing hole bush and two serrated cutters with fixing screws.

Actuating lever in two parts with stop catch, nut, check screw and spiral spring, sleeve with set screw and spiral spring and keep pin.

Link actuating upper contact.

Upper contact consisting of punch with ivory washer, connecting piece, insulating bush, two washers, securing bush, case and nut.

Cable.

Lower contact consisting of contact, insulating bush, two washers, securing bush, case, nut cap and spiral spring.

Extractor with axis pin, spiral spring and lanyard.

Description.—The electric lock consists of a steel frame fitted at the upper end with an actuating lever with sleeve, by means of which it is raised or lowered, thus admitting of the insertion of the tube into, or its withdrawal from, the vent. The lower portion of the frame is furnished with an extractor and an insulated contact. Near the centre of the frame is an upper contact, with insulated punch with connecting piece and case, which is connected by an insulated cable to the contact at the lower end of the lock frame. The upper contact is withdrawn from, or pushed into, the firing position by means of an actuating link in the frame, which engages the cam portion of the actuating lever in the upper part of the lock, so arranged that, when the lock is in position and the actuating lever depressed, the point of the punch is forced partially into the head of the vent-sealing tube and contact made. The punch is kept pressed forward by a flat spring provided in the upper end of the lock frame ; the free end of the spring is forked and engages the outer end of the upper contact case, which is prepared for its reception.

The punch is arranged for a maximum protrusion of .09-inch through the firing hole and is withdrawn within the face of the firing hole bush by means of the inclined grooves and corresponding projections of the contact case and actuating link respectively, when the actuating lever of the lock is raised.

The underside of the lock is provided with two serrated cutters, which grip the head of the vent-sealing tube and ensure a clean surface for the earth return.

The lock is secured during firing by means of a catch on the sleeve of the actuating lever, which engages with a projection on the box slide when the lock is in the firing position. To prevent the lock from sliding out of the slide box, when the actuating lever is raised, a stop

catch is fitted to the actuating lever, which engages with a stop on the lock frame.

When placing the lock in position or withdrawing it from the gun, the bronze nut of the stop catch must be pressed in so as to allow the actuating lever to be raised beyond the stop on the lock frame, as it is only with the lever in this position that the lock can be inserted or withdrawn.

Lock, Percussion.

The following are the principal parts of the lock :—

Lock frame with firing hole bush and striker retaining cap.

Actuating lever in two parts with stop catch, nut, check screw and spiral spring, sleeve with set screw and spiral spring and keep pin.

Striker in two parts with keep pin and firing pin.

Main spring.

Trigger in two parts with spiral spring.

Safety plunger with spiral spring.

Extractor with axis pin, spiral spring and lanyard.

Description.—The percussion lock consists of a steel frame furnished with an actuating lever, with sleeve and stop catch and an extractor, generally similar to those of the electric lock. The lock frame is furnished with a striker, main spring, trigger and safety plunger. The striker is cocked automatically when the actuating lever is raised and is maintained in the cocked position by the trigger. The trigger is provided with a loop for the attachment of the service lanyard. The safety plunger is fitted to the lower portion of the lock frame and serves to ensure that the vent-sealing tube is not fired before the actuating lever is lowered. When the breech is closed and the actuating lever lowered, the safety plunger is automatically withdrawn from the striker, which is then free to strike the vent-sealing tube when the trigger is pulled.

Action of Firing Mechanism.

After closing the breech, the electric or percussion locks, respectively, are forced downward into a central position over the head of the vent-sealing tube in the gun by means of the actuating lever of the lock being depressed by hand, until the sleeve engages the projection on the slide box.

For electric firing a contact bolt is provided in the hinge joint of the carrier ring. The bolt is actuated by means of a cam groove in the rack pinion in such a manner that, when the breech screw is locked in the gun, the last movement of the mechanism in closing the breech forces the bolt through the recess in the side of the breech screw and makes contact with the lower contact of the electric lock. In opening the breech, the first movement of the rack pinion serves to withdraw the contact bolt clear of the breech screw and thus admits of the latter being unlocked and withdrawn. The contact bolt has, fitted to its inner end, an insulated contact for engaging the lower contact of the electric lock. A length of electric cable is passed through the contact

bolt and carrier ring, one end of the cable being fitted and soldered into the above-mentioned contact and the other end being similarly secured to an outer insulated connecting piece, with retaining nut and connection, for use with the expendable cable of the firing gear. This connecting piece is secured to the right side of the breech mechanism frame by means of a bronze bracket and fixing screws. The recess for the cable of the contact bolt in the hinge joint of the carrier ring is enlarged at the outer end so as to admit of the contact bolt being removed or replaced without making or breaking any soldered joint. A removable filling piece is fitted to the outer end of the recess and secured by a fixing screw.

The electric circuit is completed through the metal of the vent-sealing tube, gun and carriage to the firing battery.

BREECH MECHANISM.

"C" MARK IX GUN.

(Plate IV.)

The guns are fitted with single motion breech mechanism converted from the mechanism of the *Mark IX* guns. The mechanism is so arranged that by one pull on the lever, the breech screw is automatically unlocked and swung into the loading position. After loading, one thrust on the same lever inserts the breech screw and turns it into the locked position. For electric firing an electrical safety arrangement is provided on the breech screw and bevel wheel with crank, so arranged as to prevent the electric firing circuit being completed until the breech is closed and the breech screw locked in the gun; for percussion firing, the striker of the percussion lock is retained in a position of safety by the safety plunger until the breech screw is securely locked in the gun.

The names of the principal parts of the breech mechanism are shown on Plate IV.

DESCRIPTION OF BREECH MECHANISM.

Breech screw.—The breech is closed by a steel parallel screw having six portions of the screw thread removed longitudinally so as to admit of the breech being closed (when the breech screw is pushed home) by the twelfth of a turn.

A bronze end plate, with steel roller path for partially revolving the breech screw, is secured to the rear face by fixing screws. A steel rack for withdrawing the screw is provided on the right side. Two contact pieces with insulating block and two contact plugs for electrical connection with expendable cables, are provided on the upper portion and a lock safety lever, with actuating bolt and spindle and a lock guide bracket are provided on the lower portion of the breech screw.

The interior of the breech screw is recessed for the reception of the axial vent.

Obturing pads and discs.—Obturation is obtained by means of a mushroom-headed axial vent of steel passing through the centre of the breech with two pads (front and rear), with centre steel ring

and a pair of metal discs. The inner face of the breech screw is flat, and between it and the head of the vent the pads with centre ring and the discs are arranged. The pads are made of asbestos worked up with mutton suet to a proper consistency and enclosed in strong canvas covers; they are reduced to shape and pressed in a hydraulic machine. The pads with centre ring are enclosed between two protecting discs.

The front and rear protecting discs are of tin, each having a steel ring round the outer circumference. The rear disc is also bushed with a ring of manganese bronze.

If correctly assembled the whole should fit together compactly.

Thin steel adjusting discs are provided for insertion behind the rear protecting disc when found necessary.

Action.—When the breech screw is swung into the gun the pads and discs enter the chamber with ease; on turning the breech screw the obturating pads are pressed home into the coned seating in the gun by the travel of the screw. The bore is thus closed by the pads which are in contact with the bore all round the circumference, while the mushroom-head of the vent receives the force of the gas on discharge. On firing the gun the pressure acts on the mushroom-head of the vent and compresses the pads against the breech screw, thus causing them to expand. This expansion is radial to the axis and equal in every direction and is sufficient to prevent the escape of gas. On the pressure being removed elasticity comes into play and the pads and discs can be withdrawn from the coned seating as soon as the screw is unlocked:

Axial vent.—The axial vent consists of a mushroom-headed steel bolt with a fire channel through its longer axis, enlarged at the rear end to form a tube chamber. Externally it is provided with screw threads to engage those of the vent nut and thrust collars for the attachment of the slide box. The spiral spring, sleeve, washer and nut are placed upon the vent in the order named.

Carrier ring.—The carrier ring for supporting the screw when withdrawn is of bronze and is hinged by a bolt to the breech mechanism frame on the right side. The hinge joint is provided with a roller frame with eight coned rollers and two bearing plates. A breech mechanism lever, having a cross-handle at one end and furnished near the other end with a bevel wheel free to revolve on its axis, is hinged to the lower end of the carrier hinge bolt. Another bevel wheel gearing with the upper side of that on the breech mechanism lever is keyed to the carrier ring hinge bolt and a toothed segment bracket, having corresponding teeth, is attached to the lower portion of the breech mechanism frame so as to engage the opposite side of the bevel wheel on the lever. The gear is so arranged that by moving the breech mechanism lever through an angle of 190° in opening the breech, the breech screw is unlocked, withdrawn and swung into the loading position. The reverse action takes place in closing the breech. The breech mechanism lever is provided with a catch which engages a bracket on the right side of the breech mechanism frame and serves to retain

the mechanism in the open position. The catch is released by hand by means of an actuating lever pivoted to the under side of the breech mechanism lever.

Breech mechanism frame.—The frame is of bronze and is attached to the breech face of the gun by fixing screws. Two lugs for supporting the hinge joint of the carrier ring and a toothed segment bracket for actuating the bevel pinion of the breech mechanism lever, are provided on the rear face at the right. A bracket catch retaining breech mechanism lever and a socket for the reception of the catch carrier ring are attached to the left side of the frame. An insulated terminal stud for use with expendable cables is provided on the right side of the frame.

FIRING MECHANISM.

“C” MARK IX GUN.

(Plate V.)

The firing mechanism is designed for percussion firing and for electric firing with wireless tubes and is so arranged that the gun cannot be fired before the breech is fully closed.

Box, Slide.

The slide box in which the percussion lock and the electric lock slide is of steel in two parts and is secured to the axial vent by thrust collars.

Lock, Electric.

The following are the principal parts of the lock :—

Lock frame with flat spring, firing hole bush and two serrated cutters with fixing screws.

Actuating lever in two parts with stop catch, nut, check screw and spiral spring, sleeve with set screw and spiral spring and keep pin.

Link, actuating.

Needle, spindle with insulating bush in two parts, insulating and bronze washers, punch with ivory washer, sleeve, spring and securing nut, needle case, needle securing nut, plug and cap.

Extractor with axis pin, spiral spring and lanyard.

Description.—The electric lock consists of a steel frame fitted at the upper end with an actuating lever with sleeve, by means of which it is raised or lowered, thus admitting the insertion of the tube into, or its withdrawal from, the vent. The lower portion of the frame is furnished with an extractor. Near the centre of the frame is a needle spindle with insulating bushes, case and steel punch with ivory washer, connected at the outer end by means of an expendable cable to an insulated contact on the upper side of the breech screw. The needle is withdrawn from, or pushed into, the firing position by means of an actuating link in the frame which engages the cam portion of the actuating lever in the upper part of the lock, so arranged that when the

lock is in position and the actuating lever depressed the point of the punch is forced partially into the head of the vent-sealing tube and contact made. The punch is kept pressed forward by a flat spring provided in the upper end of the lock frame. The free end of the spring is forked and engages the outer end of the upper contact case which is prepared for its reception.

The punch is arranged for a maximum protrusion of $\frac{1}{16}$ -inch through the firing hole and is withdrawn within the face of the firing hole bush by means of the inclined grooves and corresponding projections of the needle case and actuating link respectively, when the actuating lever of the lock is raised.

The underside of the lock is provided with two serrated cutters which grip the head of the vent-sealing tube and ensure a clean surface for the earth return.

The lock is secured during firing by means of a catch on the sleeve of the actuating lever, which engages with a projection on the box slide when the lock is in the firing position. To prevent the lock from sliding out of the slide box when the actuating lever is raised, a stop catch is fitted to the actuating lever, which engages with a stop on the lock frame.

When placing the lock in position or withdrawing it from the gun the bronze nut of the stop catch must be pressed in so as to allow the actuating lever to be raised beyond the stop on the lock frame, as it is only with the lever in this position that the lock can be inserted or withdrawn.

Lock, Percussion.

The following are the principal parts of the lock :—

Lock frame with firing hole bush and striker retaining cap.

Actuating lever in two parts with stop catch, nut, check screw and spiral spring, sleeve with set screw and spiral spring and keep pin.

Striker in two parts with keep pin and firing pin.

Main spring.

Trigger in two parts with spiral spring.

Safety plunger with spiral spring.

Extractor with axis pin, spiral spring and lanyard.

Description.—The percussion lock consists of a steel frame furnished with an actuating lever with sleeve and stop catch and an extractor generally similar to those of the electric lock. The lock frame is furnished with a striker, main spring, trigger and safety plunger. The striker is cocked automatically when the actuating lever is raised and maintained in the cocked position by the trigger. The trigger is provided with a loop for the attachment of the Service lanyard. The safety plunger is fitted to the lower portion of the lock frame and serves to ensure that the vent-sealing tube is not fired by the striker before the actuating lever is lowered. When the breech is closed and the actuating lever lowered, the safety plunger is automatically withdrawn from the striker, which is then free to strike the vent-sealing tube when the trigger is pulled.

ACTION OF FIRING MECHANISM.

After closing the breech the electric or percussion locks, respectively, are forced downwards into a central position over the head of the vent-sealing tube in the gun by means of the actuating lever of the lock being depressed by hand until the sleeve engages the projection on the box slide.

For electric firing an insulated contact piece is provided on the upper side of the breech screw, to which the needle spindle of the electric lock is connected by an expendable cable. Another insulated contact is fitted to the bevel wheel with crank, which is connected by an expendable cable to an insulated terminal on the right side of the breech mechanism frame. The contacts are so arranged that when the breech is closed and the breech screw locked in the gun electrical connection is made. The electric circuit is completed through the metal of the vent-sealing tube, gun and carriage to the firing battery.

For percussion firing, an actuating bolt is provided in the hinge joint of the carrier ring. The bolt is actuated by means of a cam groove in the rack pinion in such a manner that when the breech screw is locked in the gun the last movement of the mechanism in closing the breech forces the bolt through the recess in the side of the breech screw and engages the actuating bolt safety lever in the screw. The safety lever spindle and lock safety lever in the carrier ring are then partially revolved, engaging the lower end of the safety plunger in the lock, thus releasing the striker spindle, which is then free to go forward and fire the vent-sealing tube in the gun when the trigger is pulled.

BREECH MECHANISM.

MARKS X, X^v AND X* GUNS.

(Plate VI.)

The guns are fitted with a "Single motion breech mechanism." The mechanism is so arranged that by one pull on a lever the breech screw is automatically unlocked and swung into the loading position. After loading, one thrust on the same lever inserts the breech screw and turns it to the locked position. At the same time the striker of the lock is retained in a position of safety until the breech screw is securely locked and the breech mechanism lever quite home.

The names of the principal parts of the breech mechanism are shown on *Plate VI*.

DESCRIPTION OF BREECH MECHANISM.

Breech screw.—The breech is closed by a parallel screw of the Welin type, which differs from the ordinary interrupted screw in having a larger amount of thread in proportion to its length (in this case there are nine sections of screw threads and three sections plain) by arranging segments at varying diameters, the breech opening of the gun being prepared in a corresponding manner. The interruptions in the gun are arranged to accommodate the segments of the screw of largest diameter. Thus, when the screw is unlocked, these segments pass into the interruptions and the segments next smaller in diameter unlock into the spaces left vacant by the larger ones.

The interior of the screw is recessed to fit over a circular projection (or pintle) on the front of the carrier, to which it is connected by interrupted screw threads, also for the reception of the axial vent.

A projecting flange is formed at the rear end of the screw and upon the rear face is a stud to engage the outer end of the "Link, breech screw."

A hard steel piece, provided with a recess to engage the "Catch, retaining breech screw," is fitted in the rear face of the breech screw on the right side.

Obturator.—Obturation is obtained by means of a mushroom-headed axial vent of steel passing through the centre of the breech screw and carrier, with a pad and a pair of metal discs. The inner face of the breech screw is flat and between it and the head of the vent the pad and discs are arranged. The pad is made of asbestos, worked up with mutton suet to a proper consistency and enclosed in a strong canvas or wire mesh cover; it is reduced to shape and pressed in a hydraulic machine. The pad is enclosed between two protecting discs.

Mark I obturators (originally issued with the guns) consist of a pad with front and rear protecting discs of tin or aluminium cadmium. The outer circumference of front and rear discs is protected by a steel ring and the rear disc is also bushed with a ring of manganese bronze.

Mark II obturators differ from *Mark I* above in the pad being heavier and of slightly different shape. The rear protecting disc is of tin, bushed with a ring of manganese bronze and having a steel ring round the circumference. The front protecting disc is of copper, shaped to fit the front of the pad and is provided round the outer edge with a split steel ring, which is arranged to suit the seating for obturator in the gun.

The *Mark III* obturator differs from previous patterns principally in the pad having an outer cover of wire mesh and in weight, which differs considerably in manufacture. The dimensions for adjustment and replacement purposes will, however, be those laid down for the *Marks I and II*.

The obturator is of the steep-coned type.

The angle of the cone seating in the gun and of the obturator is 13-degrees, 14-minutes, 48·7-seconds.

If correctly assembled the whole should fit together compactly.

Action.—When the breech screw is swung into the gun, the obturator enters the chamber with ease; on turning the breech screw, the obturating pad is pressed home into the coned seating in the gun by the travel of the screw. The bore is thus closed by the pad which is in contact with the bore all round its circumference, while the mushroom head of the vent receives the force of the gas on discharge. On firing the gun, the pressure acts on the mushroom head of the vent and compresses the pad against the breech screw, thus causing it to expand. This expansion is radial to the axis and equal in every direction and is sufficient to prevent the escape of gas. On the pressure being removed, elasticity comes into play and the obturator can be withdrawn from the coned seating as soon as the screw is unlocked.

When the temperature of a pad in a steep-coned obturator is probably less than 50° Fahr. and reduced charges are about to be used, the pad should be thoroughly softened by immersion in hot water prior to the practice being commenced. The efficiency of the gun will be somewhat impaired, as regards rate of fire, if firing is commenced with the pad frozen.

Axial vent.—The axial vent consists of a mushroom-headed steel bolt with a fire channel through its longer axis, enlarged at the rear end to form a tube chamber; externally, it is provided with a feather to engage in a featherway in the sleeve, screw threads to engage those of the vent nut and interrupted thrust collars for the attachment of the slide box. The sleeve, spiral spring, washer, nut and No. 1 anti-friction washer are placed upon the vent in the order named.

The sleeve is a hollow cylinder of steel, provided internally with a featherway to engage the feather on the axial vent and externally with a feather to engage in a featherway in the interior of the carrier and so prevent the axial vent revolving and the slide box from becoming disconnected.

The No. 1 anti-friction washer is placed over the outer end of the vent to the rear of the vent nut, so as to prevent jamming between the latter and the inner face of the slide box in the gun.

Carrier.—The carrier body is of manganese bronze and is hinged by a bolt to the breech mechanism frame on the right side. The hinge joint is provided on the upper and lower sides with steel cups forming races for the anti-friction balls of the ball-bearings.

The carrier extends across the breech opening of the gun, having upon its front face a large cylindrical projection (or pintle), which forms a pivot for the breech screw. The projection (or pintle) is provided on its exterior with interrupted screw threads corresponding with those in the interior of the breech screw and is recessed to receive the axial vent with its fittings.

A catch with spiral spring and bracket, is fitted to the underside of the carrier for retaining the breech mechanism lever in the closed position.

A hard steel piece with a recess for the plunger of the catch, retaining carrier is fitted to the underside of the hinge joint.

A stop for breech screw when unlocked, is formed by means of a hard steel piece secured by two screws on the upper side of the carrier so as to engage with the boss of the "Link, actuating breech screw." A hole is prepared in the rear face of the carrier near the right side for "Hook, supporting cable."

A steel stud, with washer, nut and keep pin is screwed into the interior of the carrier and forms an axis stud for the link pinion. The stud is secured when in position by means of a check screw.

Lever, breech mechanism.—The breech mechanism lever is of steel, having a spindle at one end prepared with three featherways on the exterior for the reception of the breech mechanism lever pinion. The lever is hinged to the underside of the carrier and secured by a nut

and keep pin. The opposite end of the lever is provided with a gun-metal handle. A recess is formed in the underside of the lever for the reception of the upper end of the retaining catch plunger.

Pinion, breech mechanism lever.—The breech mechanism lever pinion is of manganese bronze and is provided with teeth which engage with corresponding teeth in the link pinion. To facilitate assembling, the upper side of the pinion is marked with the word "Top."

Pinion, link.—The link pinion is of steel and works on an axis pin in the interior of the carrier. The pinion has four teeth formed on one side of the circumference, which engage with corresponding teeth on the breech mechanism lever pinion. Projecting lugs, with axis pin and set screw on the opposite side, form a hinge joint by which the "Link, breech screw," is connected. The pinion is also fitted with a cam plate having a cam groove for the reception of the inner end of the guide bolt of the "Link, actuating lock."

Link, actuating breech screw.—The "Link, actuating breech screw," is of steel, hinged at one end to the link pinion and at the other end to the stud on the outer face of the breech screw.

Link, actuating lock.—The "Link, actuating lock," is of steel and slides in a recess in the rear face of the carrier. It is provided near one end with a steel guide bolt and adjustable bush and locking plate for engaging the cam groove in the link pinion. A recess is formed in the other end of the link for the reception of the guidebolt of the lock, electric and percussion, "E."

Catch, retaining breech screw.—Is a hollow steel cylinder placed within the recess in front of the carrier and kept pressed forward by a spiral spring inside it. Externally it is provided with a feather, which by gearing into a featherway in the carrier prevents its turning and also with two projections, one to engage in the recess in the flange of the breech screw and the other to effect the withdrawal of the former by coming into contact with the face of the breech of gun when closing the breech.

Hook, supporting cable.—The hook is of bullmetal (latest manufacture steel metal plated) and is fitted together with a spring washer to the rear face of the carrier near the right side by a securing screw.

The hook consists of a disc upon which two projections are formed and bent in opposite directions to form a double hook, for the purpose of receiving and supporting the electric cable between the electric lock and the contact on the gun. When placing the cable in position the hooks must be horizontal; they are afterwards turned to the vertical position.

Frame, breech mechanism.—The breech mechanism frame is of bronze and is attached to the breech face of the gun by fixing screws. Two lugs prepared for the reception of the ball-bearing bushes for supporting the hinge joint of the carrier, are provided on the rear face. Clamping nuts and set screws are provided for securing the ball-bearing bushes in position.

A hole is prepared on the left side of the frame for a steady pin and a plate for "catch, locking loading tray" is secured by screws.

A hole is also prepared in the upper lug of the frame for the "hook, supporting cable" in order to maintain interchangeability with Naval Service. The hole will be filled with a plug of greased tow in Land Service.

Catch, retaining carrier.—The catch retaining carrier consists of a steel plunger with spiral spring contained in a bronze bracket which is attached to the right side of the gun at the breech immediately in front of the breech mechanism frame. The bracket is so arranged that the plunger engages the recess in the hard steel piece on the underside of the carrier hinge joint when the carrier is swung into the loading position.

FIRING MECHANISM.

MARKS X, X^v AND X* GUNS.

(Plate VII.)

The firing mechanism is designed for percussion firing and for electric firing with wireless tubes and is so arranged that the gun cannot be fired before the breech is fully closed.

The slide box "A," in which the percussion and electric lock slide, is secured to the outer end of the axial vent by interrupted thrust collars, the lock being automatically moved over, or away from, the vent by the closing or opening of the breech.

Upon the left side of the slide box is fitted a safety slide which retains the needle of the lock clear of the vent sealing tube in the vent except when the breech is fully closed.

An extractor in two parts is mounted upon an axis pin between the sides of the slide box to automatically extract the fired vent-sealing tube from the vent. The extractor is actuated by an actuating plate and toe-piece fitted to the front of the lock frame and a small stop pin with spiral spring is fitted to the slide box in such a manner as to retain the extractor in either the closed or open positions.

A "bolt, retaining tube" is fitted to the slide box to prevent the tube setting back in closing the breech.

Box, Slide, "A."

The following are the principal parts of the slide box :—

- Body with safety slide with three fixing screws.
- Extractor in two parts with axis pin, collar and keep pin.
- Tube retainer bolt with head, keep pin and spiral spring.
- Stop pin with spiral spring.

Lock, Electric and Percussion, "E."

The following are the principal parts of the lock :—

- Lock frame with plate actuating extractor and two screwed rivets, tripping-piece and two screwed rivets, cylindrical toe-piece, toe-piece retaining plate with fixing screw, firing hole bush and guide bolt bush.

Needle with insulator and keep screw. Mark II firing pin, retaining and locking nuts, sleeve, spring and securing nut for use with expendable cable.

Needle insulating bush and two washers.

Sheath with nut.

Main spring.

Case with fixing screw and cap.

Trigger in two parts with keep pin and spiral spring.

Firing arc with axis pin, collar and keep pin.

Cocking handle.

Guide bolt in two parts with keep pin and spiral spring.

Description.—The lock consists of a steel frame provided on the front face with actuating plate, tripping-piece and toe-piece for actuating the extractor in the slide box. The frame is also furnished with a steel guide bolt which engages with a recess for its reception in the "link, actuating lock" on the carrier. A case containing an insulated steel needle, sheath with nut and main spring is secured to the rear face of the lock frame. The inner end of the needle is prepared with a firing pin which projects through a firing hole bush in the front face of the lock frame and engages the head of the vent-sealing tube in the gun. The outer end of the needle is furnished with a nut and sleeve with spring and securing nut for the attachment of the expendable cable for electric firing. A cocking handle is provided on the rear end of the sheath by means of which the needle is pulled into the cocked position and retained by the trigger, which engages with a projection on the sheath. A firing arc is pivoted to the rear end of the trigger by means of which the latter can be pulled by the firing lanyard from either side of the gun.

Action of Firing Mechanism.

In closing the breech, the electric and percussion lock "E" is forced in an outward direction by means of the cam groove of the link pinion and the "link, actuating lock" in the carrier, so as to mask the vent-sealing tube in the gun, and is pushed into a central position over the head of the tube by the last movement of the breech mechanism lever.

In opening the breech the first movement of the breech mechanism lever withdraws the lock in the slide box, causing the projection on the sheath to engage the safety slide on the slide box, thus withdrawing the needle to the rear clear of the vent-sealing tube in the gun, and on continuing the motion of the lever, the lock is withdrawn by the "link, actuating lock" until the vent-sealing tube in the gun is unmasked.

REMOVING AND REPLACING BREECH MECHANISM.

Care must be taken not to indent or damage the components and a hammer should never be used unless with a piece of wood or soft metal to transmit the blow.

The fittings should be examined frequently as to their condition in respect to wear in order that, if necessary, special examination may be called for. See Notes, page 24.

Removal of Parts.

This is done with the breech fully open, except where otherwise stated.

Mark IX Gun.

Electric or percussion lock.—Press in stop catch, raise actuating lever fully and disengage from slide box.

Slide box.—Turn through a quarter circle, disengage parts and remove.

Vent and obturator.—Remove vent nut, washer and spring and withdraw vent and obturator from front of screw.

Endplate, rack and breech screw.—Run home breech screw in the gun, remove fixing screws and take off endplate, turn screw to the locking position by hand and withdraw rack, turn and withdraw screw and swing to loading position, pull out retaining clip and push forward, sling and remove screw from the front of carrier ring.

Clip, retaining.—This will be forced out of its recess by the action of its spring as the screw is removed.

Bevel wheel with crank.—Unscrew the set and securing screws and remove wheel from its pivot.

Bevel wheel, rack pinion and contact bolt.—Unscrew set screw at bottom of hinge bolt, screw eye-bolt into top of hinge bolt and draw upwards; the bevel wheel, rack pinion and contact bolt may then be withdrawn.

Carrier ring and roller frame.—Sling and remove carrier ring, taking care to receive the roller frame and rollers.

Lever, spindle worm and Spindle worm.—Unscrew the screw of lever and take off, unscrew set screw of spindle and withdraw the latter.

Worm-wheel, worm and washers.—Remove screw bolt from cover; the worm-wheel, worm and washers may then be withdrawn from recess in frame.

"C" MARK IX GUN.

Electric or percussion lock.—Remove the expendable electric cable from the electric lock. Press in stop catch, raise actuating lever fully and disengage from slide box.

Slide box.—Turn through a quarter circle, disengage parts and remove.

Vent and obturator.—Remove vent nut, washer, sleeve and spring and withdraw vent and obturator from front of screw.

Endplate, rack and breech screw.—Run home breech screw in gun, remove fixing screws and take off endplate, turn screw to the locking position by hand and withdraw rack, turn and withdraw screw and swing to loading position, pull out retaining clip and push forward, sling and remove screw from front of carrier ring.

Clip, retaining.—This will be forced out of its recess by the action of its spring as the screw is removed.

Bevel wheel with crank.—Remove the expendable electric cable from the contact. Unscrew the set and securing screws and remove wheel from its pivot.

Breech mechanism lever, lower and upper bevel wheels, rack pinion and actuating bolt.—Remove keep pin and nut at bottom of hinge bolt, screw eye-bolt into top of hinge bolt and draw upwards; the breech mechanism lever, lower and upper bevel wheels, rack pinion and actuating bolt may then be withdrawn.

Carrier ring and roller frame.—Sling and remove carrier ring, taking care to receive the roller frame and rollers.

Toothed segment bracket.—Remove the fixing screws and withdraw the bracket.

Catches, retaining breech mechanism lever and carrier ring.—Remove the fixing screws and withdraw the respective brackets with catches.

Terminal stud.—Unscrew the retaining nut and remove the terminal.

MARKS X, X^v AND X* GUNS.

Lock and box, slide.—Remove the expendable electric cable from the lock. Draw back the guide bolt of the lock, turn the lock and slide box through a quarter circle in an upward direction and remove separately or together.

Vent, axial, and obturator.—The axial vent, with spring, nut and washer and the obturator, will be removed in the usual way, the sleeve which forms part of the axial vent being removed from the recess in the carrier to the front after the breech screw has been removed.

Breech screw.—Disconnect the "link, actuating breech screw" from "link, pinion" by removing the check screw and axis pin, compress the breech screw retaining catch and turn the breech screw on the carrier until the link is clear of its slot and take the latter off; disengage the threads on the carrier from those in the interior of the breech screw, which then sling and remove. The catch will then be forced out of its seating by the spring.

Link, actuating lock.—Remove fixing screw and locking plate, then turn the adjustable bush until the arrow marked "ENTER" coincides with the arrow in the locking plate recess; the bush and guide bolt can then be withdrawn to the rear. Slide the link to the left and remove by drawing to the rear.

Carrier.—Sling this, as a preventative. Remove keep pin and nut from lower end of hinge bolt and the preserving screw from the top end, replace the latter by the eye-bolt provided for the purpose and remove the hinge bolt. Release set screw and unscrew upper ball-bearing bush and take out the anti-friction balls. Release set screw and partly unscrew the lower ball-bearing bush, when the carrier can be withdrawn; complete the removal of the lower ball-bearing bush and anti-friction balls. Remove keep pin and nut from breech

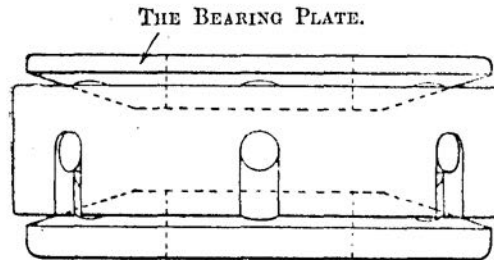
mechanism lever and withdraw the lever; the lever pinion may now be withdrawn from its bearing. Remove keep pin and nut from the link pinion stud and withdraw the link pinion. Unscrew the fixing screws of bracket catch retaining breech mechanism lever and remove the bracket, remove keep pin and nut and withdraw catch and spiral spring through hole in bracket.

Hook, supporting cable.—Unscrew the securing screw and the hook is released.

ORDER OF REPLACING THE MECHANISM.

The order in which the mechanism may be replaced will be the reverse of the foregoing; but, however, in the case of hinge bolts having coned roller frame, care should be taken to put the frame in position, as shown in the sketch below, the anti-friction rollers being embedded in tallow or other fatty matter, which will serve to retain them while assembling the frame and afterwards as a lubricant.

After the mechanism has been re-assembled great care should be taken to ensure that the breech and carrier swing truly central in the breech opening. This is accomplished by adjusting the ball-bearing bushes until the central position is obtained with the carrier in the closed position.



NOTES.

When examining the breech fittings, care must be taken to test the concentricity of the striker with the tube in the vent. For this purpose a "Gauge, striker, eccentricity" is provided, which is suitable to fit the tube chamber of the vent. In the head of the gauge is a removable plug upon which the position of the striker point is indicated when the striker is cocked and released with the gauge in position. If the indent made by the striker point in the gauge is found to be so much eccentric as to be likely to cause missfires with either percussion or electric firing further examination should be made to ascertain the portion of the mechanism in fault and steps taken to have it repaired or exchanged.

SIGHTS.

The *Mark IX* gun is sighted on both sides, the tangent sights being fitted to a sight ring which is shrunk round the jacket and secured by a set screw and the foresights in the bronze brackets which are attached to the trunnion ring of the gun by fixing screws.

The *foresights* are of the drop pattern, and consist of a pillar with a small steel acorn point and a sighting blade to facilitate laying, jacket and socket. The socket is permanently fixed in the gun. The pillar locks into the socket with a bayonet joint and is secured from turning by a projection on the jacket which drops into a recess in the socket when the sight is in its true position. The sight cannot be removed without first raising the jacket and turning the pillar round a quarter of a circle.

The sights are "Left" and "Right" respectively and are so stamped, the vertical edge of the sighting blade being turned inwards in each case when the sights are in position in the gun.

The *Mark I tangent sights* are of steel, having bars triangular in section with a rack on the front face gearing with the pinion of the automatic clamp "B," and graduated with a degree scale to 8° , reading to five minutes. The rear faces are fitted with aluminium crown metal range strips graduated for a full charge. The crosshead is provided with a deflection leaf having a sighting blade with V notch for "Right" or "Left" sights respectively and is graduated on the lower side with a deflection scale giving 2° deflection right and left.

An indicating arrow is engraved on the lower side of the deflection leaf to facilitate reading the scale.

The *Mark II tangent sights* differ from *Mark I* in being provided with traversing screws and deflection nuts, having a quicker pitch. The sights are made "Right" and "Left" for guns on *Marks III and IV* barbette carriages respectively, each sight having two range strips—one for a full charge and the other for a three-quarter charge. For automatic and rocking bar sights see page 37.

*Marks X, X^r and X** guns are not fitted for sights. For automatic and rocking bar sights see pages 47 and 48.

*List of Lubricating Holes in Breech Mechanism,
B.L. 9.2-inch, Mark IX Gun.*

Fitting to be lubricated.	Lubricating Holes.	
	No.	Position.
Breech mechanism frame	3	2 on lugs for worm spindle bearing, and 1 on right rear face, all to bearing for worm spindle.
Bevel wheel with crank	2	1 on rear face at right of roller, accessible with breech screw locked, 1 on roller to roller bearing.
Carrier ring hinge bolt	1	Top of hinge bolt.
Worm spindle lever, heavy	2	On handle sleeve.
Carrier ring	2	1 on left rear face to friction roller for breech screw; 1 at right rear on top of cover for roller frame.

*List of Lubricating Holes in Breech Mechanism,
B.L. 9·2-inch, "C" Mark IX Gun.*

Fitting to be lubricated.	Lubricating Holes.	
	No.	Position.
Bevel wheel with crank	2	1 on rear face at right of roller, accessible with breech screw locked and 1 on friction roller to roller bearing.
Carrier hinge bolt	1	On top.
Carrier ring	2	1 on left rear face to friction roller breech screw and 1 at right rear on top of cover for roller frame.

*List of Lubricating Holes in Breech Mechanism,
B.L. 9·2-inch, Marks X, X^r and X* Guns.*

Fitting to be lubricated.	Lubricating Holes.	
	No.	Position.
Breech mechanism frame	1	On top lug for hinge bolt.
Carrier	4	2 on rear face at top and bottom of recess for "link, actuating lock"; 1 each on lugs for breech mechanism lever pinion, accessible with mechanism in loading position.
Carrier hinge bolt	1	Top of hinge bolt.
Link, actuating breech screw ...	2	1 to "stud, actuating breech screw," accessible with mechanism in loading position; 1 to axis pin.
Link, pinion	1	On front face at top, accessible with mechanism in loading position.
Breech screw	2	On top interruption, at right side.

Q.F. HOTCHKISS 6-PR. GUNS USED AS SUB-CALIBRE GUNS.

(Plate VIII.)

Q.F. Hotchkiss 6-pr. *Marks I and II* guns will be used with B.L. 9·2-inch *Marks X, X^r and X** guns on *Marks V, VI and VI_A* and 9·2-inch "*C*" *Marks IX* guns on *Marks V_A and V_B* barbette carriages as sub-calibre guns for practice purposes.

For description of the Hotchkiss Q.F. 6-pr. gun, see Handbook of that gun.

Sight and automatic clamps will not be required with the guns.

The sub-calibre gun is fired by means of "Lanyard, firing, No. 17," which consists of a rope lanyard with link. The link is of steel and

passes through a hole for its reception in the handle of the trigger guard on the gun. To the outer end of the link is attached a rope lanyard, by means of which the trigger is actuated and the gun fired by a direct pull of the lanyard.

B.L. 9.2-inch *Marks V to VIA* barbette carriages will be prepared for the reception of the sub-calibre gun, as may be authorized as follows:—

A cradle and crosshead of the Q.F. Hotchkiss 6-pr. carriage (*see Handbook for Q.F. Hotchkiss 6-pr.*) are mounted in two cradle trunnion brackets riveted on a saddle which is fixed to the top of the cradle of the B.L. carriage. The saddle for the *Marks VA and VB* differs from that for the *Marks V, VI and VIA* in being of increased height. Levelling screws are provided in the saddle which takes a bearing on the cradle for maintaining the longitudinal axis of the gun parallel to that of the parent gun. A platform for use when loading is attached to each side of the B.L. cradle and a stanchion is fixed at the front end of each platform for the convenience of numbers serving the gun. The platforms for the *Marks VI and VIA* are provided with a footguard, with three stanchions, a handrail, and, at the front end, with steps leading down to the sighting platform of the parent carriage. Special cams and adjusting levers for use with the automatic sighting gear, instruction plate, yard scale rings for rocking-bar sights and yard scale plates for elevation indicator gear are provided with the B.L. carriage when the sub-calibre gun is being used.

A cartridge catcher, consisting of a wood platform provided at the sides and rear with wire netting, is secured by screws over the top of the cradle of the B.L. carriage at the rear of the sub-calibre gun so as to receive the empty cartridges from the latter as they are extracted after firing.

A trap-door secured by a locking bar, is provided in the floor of the catcher at the front end so as to admit of the breech mechanism of the sub-calibre gun being assembled on or removed from the gun without necessitating the removal of the catcher.

An additional clinometer plane is cut on the cradle of the B.L. carriage to the rear of the sub-calibre gun carriage and in line with the original plane, for use when the sub-calibre gun is employed.

Ammunition.—*See Table on page 90.*

DETAILED DESCRIPTION OF METHOD EMPLOYED FOR DISMOUNTING 6-PR. SUB-CALIBRE GUN.

Stores required:—

Three 7-foot handspikes, two selvagees and gun floor shoes for all numbers.

To dismount the gun with 12 numbers:—

Remove wedge from gun, capsquares from crosshead and cartridge case catcher, place metal cover on clinometer plane on B.L. cradle and protect that on the B.L. gun by sacking, &c.

One 7-foot handspike in the bore at the breech end manned by two numbers.

A selvagee round the breech just in front of the squared portion, a handspike through this manned by four numbers, two on each side.

A second selvagee in rear of the sight bracket manned by four numbers, two on each side.

Two numbers on the muzzle, one on each side.

The gun is lifted clear, the muzzle rested on its own cradle. Another lift is then taken, the 6-pr. being carried to the rear and rested on the 9·2-inch gun. The 9·2-inch gun is now elevated as far as possible without opening the doors of the shell-pit shield.

The 6-pr. is now lifted straight back along the top of the 9·2-inch and placed on the shell-pit shield.

This can be done in 30-seconds.

Mounting is the converse of the above and can be performed in 45-seconds.

NOTE.—The loading derrick must not be used for mounting or dismounting the sub-calibre gun.

RIFLE, AIMING, 1-INCH, ELSWICK "B," MARK I.

(Plate IX.)

This apparatus, which is arranged for electric firing only, contains its own firing mechanism (the breech mechanism of the gun is not used with it).

The principal parts of the rifle are as follows :—

- (a) Barrel.
- (b) Breech ring, with set screw and keep pin, safety stop and extractor.
- (c) Carrier, with hinge pin and catch retaining breech screw.
- (d) Breech screw, with cam lever, case and set screw.
- (e) Sleeve withdrawing striker.
- (f) Striker, consisting of needle, insulating bush and washers, sheath and mainspring.
- (g) Frame, adjusting (front), with set screw.
 - Mark I with interrupted screw-thread and two handles.
 - Mark II with continuous screw-thread and two handles.
 - Mark III with continuous screw-thread and three handles.
- (h) Frame (adjusting (rear)†)

Description.—The 1-inch barrel is chambered and rifled on the Henry principle. It is prepared on the exterior at the rear with interrupted thrust collars for the reception of the breech ring—the latter, which is prepared for the reception of the breech screw, is secured in

† Either of these Marks may be on charge.

position on the barrel by means of a set screw and keep pin, being provided with lugs for the attachment of the breech mechanism of the aiming rifle; it is also fitted with a safety stop to prevent the breech being closed until the breech ring has been locked in position on the barrel. An extractor, which engages with the head of the cartridge in the rifle, is pivoted in the breech ring in such a manner that when the breech is opened and the carrier swung into the loading position the cartridge is automatically released.

The breech is closed by a parallel screw having two interruptions corresponding with the interior of the rear portion of the breech ring and is supported, when withdrawn, by a carrier hinged to the breech ring. The screw is attached to the carrier by screw-threads on the rear end, which engage with corresponding screw-threads in the carrier and is worked by means of a cam lever.

Fitted to the outer face of the breech screw is a case enclosing a mainspring, through the centre of which the striker passes. The striker is provided with an insulated needle, one end of which projects through the firing hole of the breech screw and makes contact with the electric primer of the cartridge. The outer end of the needle is furnished with two nuts.

To prevent the rifle being fired before the screw is locked and the cam lever lowered, a withdrawing sleeve is fitted over a portion of the spring case and attached to the rear end of the striker. A projection on one side of the sleeve engages with the cam portion of the lever in such a manner that the first movement of the lever, in opening the breech, automatically withdraws the striker within the face of the breech screw. The striker is automatically released when the screw is turned into the locked position and the cam lever folded forward.

METHOD OF FITTING AND USING THE APPARATUS.

The front adjusting frame is screwed over the barrel until the lines on the front of the frame and the right side of the barrel coincide and is secured by means of the set screw.

The barrel with frame should then be placed in the breech opening of the gun, the part of the frame marked "Top" being uppermost, the frame fitting in the rear end of the chamber of the gun. The *Mark I* rear adjusting frame is then placed over the rear end of the barrel, the part marked "Top" being placed uppermost, pushed into the breech opening as far as it will go and turned so as to engage with the screw threads of the breech opening. The frame should be jammed tightly into position in the breech of the gun by means of the tommy, applied in one of the holes in the frame and used as a lever. When correctly assembled the hole for the tommy should be to the left of "Up" for *Mark IX* and "C" *Mark IX* guns and to the right of "Up" for *Marks X, X^r and X** guns.

In the event of the rear adjusting frame screwing beyond the position mentioned above, thin steel discs are provided to be inserted over the rear end of the barrel as may be necessary, the frame being temporarily removed for this purpose and, in order to prevent the frame unscrewing when firing, a filling piece of hard wood is fitted to

one of the interruptions in the breech opening of the gun after the rear adjusting frame has been inserted.

When *Mark II* rear adjusting frames are supplied the method of fitting is as follows:—The barrel and front adjusting frame are inserted as before, the *Mark II* frame is placed over the end of the barrel, the part marked "Up" being uppermost and turned so as to engage with the screw threads of the breech opening. The frame should be screwed tightly home by means of the No. 10 wrench applied to the arms on the frame and used as a lever.

Engraved upon the rear face of the frame is an indicator ring with the words "Up," "Start turning and screw home"; the indicator ring is flush with the rear face of the gun when in position.

The thin steel adjusting discs used with the *Mark I* frame are not necessary when using *Mark II* frames.

The breech ring with carrier and breech screw in the open position will then be placed over the rear end of the barrel and revolved one-fourth of a turn in such a direction as will admit of the set screw in the breech ring engaging with the recess in the barrel for its reception when the set screw is screwed home. Indicator lines are engraved on the breech ring with instructions to facilitate assembling.

Care must be taken when removing the breech ring from the barrel to see that the breech screw and carrier of the rifle are always in the open position and the extractor clear of the recess for its reception in the barrel.

Elevation is obtained by means of the carriage sights and any error in line can be corrected by using the deflection scale.

The following appurtenances and implements are supplied for use with this rifle:—

Gauge, striker protrusion, No. 3.—Is used for gauging the protrusion of striker of the rifle aiming Elswick "B." The maximum protrusion being .09-inch and minimum .07-inch.

Extractor, hand.—Is used to remove the empty cartridge case after it has been released by the extractor in opening the breech.

Tommy.—This is a cylindrical steel rod about 17-inches long, tapered at one end, which is inserted in one of the holes in the *Mark I* rear adjusting frame to give additional leverage in revolving it.

Wrench, aiming rifle, No. 9.—Is used for removing the striker case or cap and small screws.

Wrench, aiming rifle, No. 10.—Is used for *Mark II* adjusting frames and all nuts.

Rifles, aiming, 1-inch—

<i>Brush, cleaning</i> <i>Rod, cleaning</i>	}	Issued for cleaning the 1-inch barrel.
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When the aiming rifle is used in guns mounted on carriages which are fitted with automatic sights and to give increased practice in laying with these sights, the ordinary cam of the automatic sights will be substituted by a cam cut to the range limit of the aiming rifle.

NOTE.

All actions and parts of the aiming rifle should be kept perfectly clean and oiled so as to keep them in good working order and prevent rust. No cutting material, such as emery cloth, is to be used for cleaning.

CARE AND PRESERVATION OF ORDNANCE AND FITTINGS.

A Memorandum of Examination is issued with each gun and should be kept in the Sub-District Office.

When a new breech screw, obturator, axial vent, or lock is taken into use, a note to that effect should be made on the Memorandum of Examination.

Any repair or alteration, authorized by List of Changes, should be noted in the Memorandum of Examination, quoting dates of alteration, number of paragraph and authority for repair.

At the conclusion of each day's firing an entry will be made in the Memorandum by the officer in charge, giving a detail of the rounds fired (including blank charges) so that an accurate record of the firing may always be kept up.

If at any time the memorandum be lost, or damaged, a duplicate can be obtained from C.I.W., by whom also, inside sheets for continuation of the record will be supplied on demand.

All ordnance will be examined after firing the number of rounds detailed below and practice should cease until the examination has been carried out.

In cases, however, when examination would happen within a series of rounds allowed for practice, and cause inconvenience, guns will be examined before practice commences, irrespective of the number of rounds completed.

For the purpose of computing the number of rounds to be allowed between examinations (providing the total number does not exceed five times a full series†) one proof is to be taken as equal to two full charges, and four three-quarter, sixteen half, or sixteen blank charges are to be taken as equal to one full charge.

The number of equivalent full rounds after which each gun must be examined is 25.

The bores of ordnance will be cleaned and oiled. When in reserve and not used for drill, the bores will be coated with a mixture of mineral jelly and beeswax, in the proportion of 95 parts by weight of the former to 5 parts of the latter. Such guns will be examined periodically to see the mixture has not been removed from any part of the bore. The mixture will be removed annually to ascertain that the bores are free from rust, when they will be recoated. If the mixture is found to be too stiff for convenient application, it should be warmed to bring it to a suitable consistency.

† If this number is 100 the total number of full, three-quarter, half, or blank, must not, when added together, exceed 500 between examination.

At the close of each day's practice, the bore of a gun is to be thoroughly washed out and muzzle depressed, when dry, the bore is to be coated with mineral jelly, or oiled, according as to whether cordite or powder charges have been used respectively.

Bores of guns should be thoroughly wiped out before firing so as not to leave an excess of oil or grease in the bore.

Obturators.

Pads should be examined to see that the canvas coverings are intact and in proper order for use. If the canvas covers are found to be loose or to overlap either of the protecting discs, the pads should be exchanged.

Pads should always be used according to their date of manufacture as marked in black paint on the canvas cover and on the outside of the pad boxes, those of the earliest date being used first.

In consequence of the unavoidable slight differences in the dimensions of the seating for the obturator in guns, it is necessary that the first time any pad is used it should be with a full charge and projectile. Spare pads should be used with a full charge at the first practice after receipt, the stencilling being then removed to show that they have been expanded.

Special boxes are provided for pads and discs in which they will invariably be kept when not in the gun, care being taken that they are properly assembled and placed under compression in the boxes.

The pads should be weighed quarterly and the results compared with the particulars in the following tables:—

Replacement limits for steep-coned obturators.

Nature.	Mark of obturator.	Weight of pad.	
		Minimum with mutton suet.	Maximum with mutton suet.
B.L. 9·2-inch Marks X, X ^v and X*	I	lbs. ozs. drs. 5 13 4	lbs. ozs. drs. 5 15 12
	II	6 4 4	6 6 12
	III	—	—

Replacement limits for slow-coned obturators.

Nature.	Weight of Pad.	
	Minimum.	Maximum.
B.L. 9·2-inch Mark IX	lbs. ozs. drs. 4 1 8 (front)	lbs. ozs. drs. 4 8 8 (front)
B.L. 9·2-inch "C" Mark IX	1 10 14 (rear)	1 14 2 (rear)
	1 15 12	2 3 4

If pads are found to be contracted, they should be soaked in a hot mixture of olive oil and tallow ; if, on the other hand, swollen or warped and difficulty is experienced in getting the fittings into position, they should be warmed through by immersion in hot water till soft, placed in position and the breech closed ; after closing the breech the pad is compressed while warm by screwing up the nut of the vent axial until the slide box can be placed in position.

Steep-coned obturators, in addition to being weighed, will be gauged by means of the maximum gauge issued with the "Press, obturator, steep coned."

If the obturators will not accept the gauge or are above the maximum weight, they will be compressed in the "Presses, obturator, steep-coned," which are provided to re-form steep-coned obturators that have become so distorted as to cause difficulty in placing them in position in the gun. The presses are shaped to receive the obturator and are fitted with a steel cover which is clamped on after the obturator has been inserted and so holds it under compression ; recesses are formed in the periphery of the press to admit of the application of the gauge whilst the obturator is under compression.

The protecting discs should also be carefully examined, and if the tin be fused, or the steel rings eroded, burred, or cracked, should be replaced by new discs. If the tin is found to have expanded over the circumferential surface of the steel ring of the rear protecting disc, the expanded tin should be filed away, care being taken not to reduce the diameter of the steel ring. Protecting discs and rings of steep-coned obturators can be demanded separately for replacement purposes as required.

When fitting the pad and protecting discs on the vent axial, care must be taken that they are in correct order. The face of the pad marked "Front" should be towards the muzzle and the discs should be placed in front or rear of the pad as marked. One or more steel adjusting discs may be required between the obturator and the face of the breech screw when the pad is compressed by firing, but the obturator should always turn freely.

The pad should be a close fit in the coned seating in the gun when the breech is closed. In order to ascertain this, slightly cover the seating with grease (a mixture of oil and tallow), then close and open the breech, with the pad and protecting discs in position, when the outer edge of the pad should be covered with grease from contact with the greased seating in the gun ; when it is found, after the above test, that the pad and protecting discs do not fit closely into the seating, adjusting discs should be inserted (one at a time) behind the rear protecting disc until the breech screw works rather stiffly in locking, owing to the pad being pressed home into the seating in the gun.

To admit of the insertion of the necessary discs, clearances are provided between the faces of the breech fittings, but the whole of these clearances would seldom be required and would not then be taken up.

In the case of guns with steep cones, the adjusting discs should be added until the breech closes tightly and with some difficulty. The breech mechanism should then be opened and closed until the pad of

the obturator becomes compressed. Before use, the pad and the discs should be well covered with tallow. Opportunity should be taken when convenient to keep cool both the obturator as well as the vent bolt. This can be most conveniently done by either pouring water over it when in position in the gun, or by sousing it thoroughly with sponge during or after firing.

Before practice with three-quarter or full charge is commenced in guns with steep cones, the pad should be thoroughly softened by immersion in hot water. During cold weather pads in all guns should be replaced once a day by others which have been immersed in hot water for a few minutes. This operation should be carried out as opportunity offers, but preferably in the morning.

CARRIAGE, GARRISON, BARBETTE, B.L. 9·2-INCH,

MARK IV.

(Plate X.)

Mark IV mounting is constructed to fire from an elevated emplacement. It admits of 15° elevation and 20° depression. It allows a recoil of about 3-feet, 6-inches, and consists principally of cradle, with hydraulic buffer, carriage and gears elevating, traversing, elevation indicator and electric firing.

CRADLE.

(Plate XI.)

The cradle consists of two cast steel sides connected at each end by transoms and at the centre by a bridge which gives rigidity to the upper part. To the front transom is attached the piston rod of the hydraulic buffer, the rear transom being formed to take the air cylinder. The inside of each side of the cradle is grooved to form guideways for the sliding blocks which fit the trunnions of the gun and are secured in position by the "Band connecting gun and buffer."

Trunnions are cast on the cradle to fit the bearings of the carriage body and ball-bearings are fitted to each trunnion to decrease the friction in elevating or depressing.

Connecting band and sliding blocks.—The gun trunnions fit into a pair of sliding blocks attached to projections formed on each side of a connecting band which is bolted around the gun in front of the trunnion coil. Into the lower part of the band is fixed the hydraulic buffer cylinder.

A combined grease box and brush is fitted to each sliding block to clean and lubricate the sliding surfaces. The brush can be adjusted to give the necessary pressure. The brush should be frequently cleaned. The lubricant used is a mixture of blacklead and tallow, in the proportion of 14-lbs. of tallow to 1-lb. of blacklead.

HYDRAULIC BUFFER AND AIR CYLINDER.

(Plate XI.)

The hydraulic buffer consists principally of a steel cylinder with stuffing box and glands, piston with rod, valve key and controlling plunger.

The *buffer cylinder*, which also forms the ram of the air cylinder, is closed at the front end by a leather washer, large gland, L-leather, stuffing-box and greased packing compressed by a manganese bronze small gland. The cylinder is connected to the gun by means of the "Band connecting gun and buffer."

The *piston, including rod*, is of steel bored out for the controlling plunger, adjusting valve and tube; two bronze rings are fitted on the piston head to prevent scoring; a port for a valve key is cut through the piston. The piston rod is connected to the front transom of the cradle by a screwed collar in rear and a nut and keep pin in front.

The *valve key* is of bronze; it is secured in the inside of the buffer cylinder and is formed to fit the sides of the port, but varies in thickness and thus regulates the flow of the liquid from one side of the piston to the other during recoil.

The *controlling plunger*, which is provided with an adjusting valve, is secured in the rear end of the buffer cylinder.

The *air cylinder* comprises two chambers, one inner and one outer, the inner being secured to the outer by means of a cap which is furnished with a controlling valve and screwed projections for attachment of a pressure gauge.

The outer air chamber is provided with a gland and a metal perforated packing ring in the front end, through which passes the buffer cylinder and towards the rear a ring is fitted internally for centralizing the inner chamber; in the rear end there is a hole leading to the intensifier. The inner air chamber is formed with a seating for the face of the controlling valve.

The escape of the air from the air cylinder is prevented by the use of liquid surrounding the perforated packing ring, this liquid being supplied from the intensifier at a slightly higher pressure per square inch than the air in the cylinder.

The *intensifier* is somewhat similar to that described hereafter for the *Mark V* mounting, page 43. The cylinder will require refilling when the piston rod of the intensifier is seen projecting about 3-inches.

To charge the intensifier, see page 71.

A *clamp adjusting intensifier* may be used to push in the piston rod and filling carried out with the aid of a funnel; on screwing up the clamp the fluid will be drawn into the cylinder. The clamp consists of two tie-rods, two cross-pieces and a compressing screw with lever.

The *air pump* is secured to the upper side of the air cylinder to which it is connected by a copper connecting pipe. The pump is used for keeping up the pressure in the air cylinder.

Action.—On recoil the gun, band, sliding blocks and buffer cylinder recoil together; the buffer cylinder is drawn off the piston rod; the liquid passing from one side of the piston to the other through the port,

checks the recoil, assisted by the resistance of the compressed air in the air cylinder. During recoil the entry of the buffer compresses the air in the air cylinder. The compressed air will, on completion of recoil, push the hydraulic buffer cylinder forward and return the gun to the firing position; the action of the controlling plunger in the hydraulic buffer and the controlling valve in the air cylinder brings the gun quietly to rest.

CARRIAGE.

The carriage consists of two built up sides of steel plates, the sides being connected by transoms. Steel castings riveted to the sides form trunnion bearings; the cap-squares are of forged steel each secured by six screws. Sections of the upper roller path are secured to the transoms; the carriage rests on a live roller ring; steel clips, front and rear, secure the carriage to the lower roller path. A sighting platform is attached to the right-hand side of the carriage; elevating and traversing the gun can also be effected from this platform. A pointer provided with a deflection scale is fitted to each side of the mounting for use with the traversing arc.

ELEVATING GEAR.

An elevating arc is attached to each side of the cradle into each of which gears a pinion actuated by bevel and wormwheel gearing. Each wormwheel has a friction clutch, formed by a series of alternate steel and metal plates. The gear is so arranged that it can be worked by handwheels, either from the sighting platform on the right or from either side of the mounting at the ground level, the former being slow motion gear and the latter quick.

TRAVERSING GEAR.

The traversing gear consists of bevel and spur wheel gearing which transmits motion to traversing pinions on the carriage, the latter engaging with the rack secured to the racer casting. The gear is actuated by the lower handwheels on the cross shaft near the front of the carriage or by an incline shaft worked by a handwheel from the left sighting platform; this latter is the slow motion gear. There is a separate quick motion gear at the rear right-hand side, worked from the sighting platform. Each upper handwheel of the gear is fitted with a folding handle and each gear is fitted with a clutch for throwing it in or out of gear as required.

ELEVATION INDICATOR GEAR.

The elevation indicator gear is used to indicate the quadrant elevation in yards when not using the sights for giving elevation. It is intended to be used when operating the elevating gear from the emplacement. It is actuated by the oscillating movement of the cradle and consists principally of an arc segment fixed to the false trunnion of the cradle trunnion and gearing with a spur pinion on a spindle held in a bracket on the carriage. The outer end of the spindle carries an adjustable pointer which reads to a yard scale

plate fixed to the spindle supporting bracket. A spiral spring is provided to prevent backlash; one end of the spring is passed over a stud on the pinion and the other end is attached to the bracket. Zinc yard scale plates graduated locally for the various charges are provided, the scale required for use being attached by screws to a fixing disc.

SIGHTS AND SIGHTING GEAR.

Parallax of Sights.

Automatic Sight.		Rocking-bar sight with telescope horizontal.	
Axis of telescope above gun axis.	Axis of telescope right or left of gun axis.	Axis of telescope above gun axis.	Axis of telescope right or left of gun axis.
21·6-inches.	58·6-inches right.	28·22-inches.	33·715-inches left.

Automatic sights.—Full description is given in the Treatise on Military Carriages.

Instructions for changing cams.—In changing cams the following instructions will be observed :—

1. To remove the roller and axle from the roller lever remove the keep pin (by means of small drift $\frac{1}{16}$ -inch diameter and hammer) and collar from the axle. Take out the cam roller. Take off the nut and collar from the axle and remove the axle towards the centre of the mounting.
2. Remove the two steady pins connecting the cam lever to the cam (by means of a drift $\frac{5}{16}$ -inch diameter and small hammer). Take out the bolts securing the cam and remove the cam.
3. To mount the required cam, the order of the instructions detailed above is reversed. Care must be taken that the cam roller and the driving edge of the cam are clean.
4. After changing a cam adjust the sight.

Rocking-bar sights.—This sight is fitted to supporting brackets on the left side of the cradle and consists principally of a worm-wheel bracket, sight bar, foresight and telescope carrier with supporting pillar.

The *sight-bar* is of steel and is pivoted to the front supporting bracket. The rear end is fitted to the rear supporting bracket and carries a hind-sight having a crosshead fitted with a deflection nut and reader. A scale plate attached to the crosshead is graduated to 2° deflection right and left.

The *foresight* consists of a straight-edge sighting blade and acorn foresight. The sighting blade is fitted in a holder so that it can be

pulled outwards and folded down when not required in the vertical position. The holder fits into an adapter. The sight is in normal adjustment when screwed down home, correction to suit individual gun-layers only being made when time permits of the gun being carefully laid on a distant target. To adjust the sight the adapter is moved from below by an adjusting screw fitted into the rocking-bar and clamped by a hexagon screw, which passes through the adjusting nut into the adapter.

The lower portion of the sight consists of a sight arc graduated in degrees. The front face of the arc is furnished with a rack; a pinion, gearing with a worm, engages the rack; the gear is actuated by a handwheel. Zinc rings on which are engraved yard scales for the various charges and 1-inch aiming rifle are provided.

TELESCOPE, SIGHTING FOR ROCKING-BAR AND AUTOMATIC SIGHT.

As hereafter described for *Mark V* mounting, page 49.

ELECTRIC FIRING GEAR.

This is generally similar to that described for *Mark V* mounting, page 50, the auto circuit breaker being replaced by a cradle and gun contact.

LOADING ARRANGEMENTS FOR USE AT GIBRALTAR.

The loading arrangements consist principally of lifts, loading trollies and loading platforms.

Two *lifts* are furnished. The lifts, with metal rails on top, form part of a circular railway, so laid as to enable the gun to be loaded at almost all degrees of traverse. A second line of rails take the loading platform.

Each *loading trolley* takes two half charges. On top a projectile carrier, with metal tray to take the projectile is pivoted which can be turned through a half-circle and clamped by a lever. A lever is hinged to the pivot bracket of the trolley for attaching the trolley to the breech of the gun.

Each *loading platform* is fitted with four flanged trucks. The inner ends of the axles have gunmetal rollers which fit under a bearing plate in the emplacement to prevent the platform upsetting. A clamping screw is provided to fix the platform to the work during loading; iron handles and guard irons are provided. The loading platform moves round with the loading trolley.

PEDESTAL, CARRIAGE, No. 4.

The pedestal consists of two semi-circular castings secured together when in position with two joint plates and bolts. It is formed with a flange at the bottom, which is bored for the holding-down bolts of the holdfast. The top is prepared for the racer.

HOLDFAST, No. 4B.

The holdfast consists of 13 anchoring plates and 52 holding-down bolts; the bolts are nutted to the bottom flange of the pedestal and embedded with the anchoring plates in concrete.

RACER, CARRIAGE, GARRISON, BARBETTE, MARK IV, B.L., 9·2-INCH.

The racer is of steel, bolted on top of the pedestal. A flange is formed on the outer face to engage the holding-down clips of the carriage. A traversing rack is screwed on above the clip flange.

ARC, TRAVERSING, No. 33.

The traversing arc is of brass and consists of three concentric rings made up of sections. The centre ring is graduated in degrees, and the two outer rings are each figured to indicate the degrees right or left traverse, the whole being secured by screws to nuts embedded in concrete surrounding the pedestal.

WEIGHT AND HEIGHT OF EQUIPMENT.

Weight Carriage on racers, 26-tons 3-cwt.
Height Axis of gun above racers in firing position, 5-feet
11·3-inches.

CARRIAGE, GARRISON, BARBETTE, B.L. 9·2-INCH, MARK IV.

List of Lubricating Holes.

Articles.	No. of Holes.	Remarks.
Blocks, sliding gun (2) ... each	2	
Brackets—		
Arc pinion and worm shaft—		
Left	1	} Provided with copper pipe for conveying lubricant.
Right	1	
Crank shaft lower, gear correcting automatic sight	2	
Cross-shaft—		
Elevating—		
Inner (3) each	1	
Outer—		
Left	1	
Right	1	
Traversing—		
Centre	1	
Left	1	
Diagonal shaft, traversing—		
Lower	1	
Upper	1	
Elevating and traversing gear, 1st motion spindles	2	
Rack pinion shaft—		
Front	1	
Rear	1	
Worm shaft, elevating—		
Lower	2	In bearing caps.
Upper (2)	—	Oil groove in bearing.
Capsquares (2) each	1	The tapped hole for lifting eye.

CARRIAGE, GARRISON, BARBETTE, B.L. 9'2-INCH, MARK IV.—*continued.**List of Lubricating Holes—continued.*

Articles.	No. of Holes.	Remarks.
Guards—		
Bevel wheel and pinion traversing—		
Front, right	2	
Rear	2	
Elevating—		
Left	1	Also oil channel in bearing.
Right	1	
Gear correcting auto-sights ...	2	
Guides, cradle (2) each	2	For lubricating sliding surfaces.
Gear, sighting, automatic—		
Levers—		
Bell cranked	2	
Cam roller	1	Also a groove for oil.
Pivot	1	
Crank, adjustable	1	
Roller ring axles (10)... .. each	1	In head of axles.
Shaft rack pinion—		
Left	—	Upper end of shaft grooved for oil.
Right	—	
Worms, elevating (2)... .. each	1	
<i>Platform, Loading.</i>		
Trucks (4) each	1	In boss of trucks.
<i>Trollies, Loading.</i>		
		3 per emplacement.
Carrier, projectile tray	—	Two oil grooves for lubricating sliding surfaces.
Pins, roller (3) each	1	
Trucks (4) each	1	In boss of truck.

SPANNERS AND SPECIAL IMPLEMENTS.

Clamp, adjusting intensifier piston.

Pipe, filling intensifier (with funnel).

Spanners :—

No. 3	For air pump valve.
No. 4	For screw, girder thrust.
No. 29	For front traversing bolts.
No. 36	For nut controlling plunger (socket with tommy No. 8).
No. 51	For filling and emptying valve connection, hydraulic buffer and pipe connections intensifier.
No. 98	For valve filling and emptying hydraulic buffer and connections, pipe connecting air pump and filling pipe.

Spanners—*continued*—

No. 141	...	...	For small plunger air pump.
No. 203	...	...	For gland and valve of cap securing inner chamber of air cylinder and filling valve, spindle intensifier.
No. 204	...	...	For cap securing inner chamber of air cylinder.
No. 205	...	...	For gland, intensifier.
No. 206	...	...	For valve filling intensifier and gland tube adjusting valves.
No. 207	...	...	For nuts elevating arc pinion.
No. 212	...	...	For nuts, arc pinion spindle.
No. 225	...	...	For 3·546-inch nuts, holdfast carriage pedestal.
No. 226	...	...	For 3·17-inch joint plate bolts and nuts, carriage pedestal.
No. 243	...	...	For studs, gland, air cylinder (with tommy No. 34).

Spanners, hydraulic buffer :—

No. 26	...	...	For screws, supporting trunnion ball-bearings.
No. 49	...	...	For plug filling-hole.
No. 55	...	...	For stuffing-box intensifier.
No. 64	...	...	For air pump, cap and plugs.
No. 81	...	...	For set screw, gland, collar hydraulic buffer.
No. 84	...	...	For nut, adjusting trunnion ball-bearings.
No. 104	...	...	For gland, large.
No. 105	...	...	For gland, small.
No. 106	...	...	For box, stuffing.
No. 107	...	...	For nut, piston rod.
No. 108	...	...	For gland, valve spindle, &c., filling and emptying, also withdrawing packing ring, air cylinder.
No. 109	For plunger, controlling (with tommy No. 32).

Screwdriver :—

No. 10	For small screws of automatic sighting gear.
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Eyes, lifting :—

No. 1	For cap-squares.
No. 2	For withdrawing piston rod.
No. 3	For cap, band connecting gun and buffer.

Lever :—

No. 4	For lengthening spanner.
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Loop, lifting :—

No. 6	For rings friction, elevating gear.
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Screws clamping cradle bridge.

Wrench, pivot :—

No. 6	For screws elevating gear.
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Tommy :—

No. 4	For screws clamping cradle bridge and No. 207 spanner.
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CARRIAGE, GARRISON, BARBETTE, B.L. 9·2-INCH,
MARK V.(FOR MARKS X AND X^V GUNS.)

(Plate XII.)

Mark V mounting is constructed to fire from a pit emplacement 8½-feet deep. It admits of 15° elevation and 10° depression; it

allows a recoil of about 3-feet 6-inches and consists principally of a cradle with hydraulic buffer, air cylinder and intensifier, carriage and gears elevating, traversing, elevation indicator and electric firing.

CRADLE.

(Plate XIII.)

The cradle consists of two steel sides, connected at the front and rear by transoms. It is prepared on the inside for the sliding bars attached to the gun. The front transom is prepared for the reception of the piston rod of the hydraulic buffer and the rear transom for the air cylinder. The elevating arcs are bolted to the cradle.

Bands and sliding bars.—The bands are front and rear. The front band is in three pieces, bolted together around the gun about the centre of gravity; the rear band is in halves, bolted together around the gun in its seating near the breech; a feather on the gun fits a featherway in the band to prevent the latter turning. The bands have projections on their side upon which are fitted sliding bars. Each bar is provided with an anti-friction metal bearing plate; the bars fit into corresponding sliding surfaces in the cradle.

Ball-bearings are fitted to the cradle to decrease the friction in elevating and consist generally of a ring of hard steel balls round the outer end of each trunnion. To form a groove for the balls to run in, round each trunnion there are two hard steel bearing rings, the outer one of which is carried in a metal nut which screws on to the trunnion.

Round the outside of the steel balls is an outer steel band, which has inside it a hard steel bearing ring held in place by a retaining ring secured by screws. A socket formed below the band fits round the stem of an adjusting screw, but it is supported when adjusted on disc springs that bear on a shoulder of the screw. The screw works in a nut formed in a projection on the carriage body and is shaped to take a spanner. On firing, the disc springs give a little and allow the shock of discharge to be taken on the main trunnion bearings and so save the balls from damage.

Fittings are provided for excluding dust from the bearings, each set consisting of a leather washer secured by screws to the inner face of the bearing and a steel spring plate to the outer face; the spring plate is made in halves to facilitate attachment or removal.

To adjust the bearings, turn the adjusting screws in the required direction; at the same time move the elevating gear by the handwheel until the gear works easily.

When adjusting the spring pressure under the cradle trunnion ball-bearings, care should be taken that the trunnion is not actually lifted out of the trunnion hole, but that the weight on the trunnion hole is merely relieved and the elevating effort eased.

The left trunnion is cast hollow and prepared for the elbow pipe of the hydraulic system. The hole is continued along the side of the cradle to the rear, where it is connected to the compressors charging accumulator of the hydraulic loading gear.

In later manufacture the right-hand cradle trunnion is engraved with one vertical and one horizontal line.

A clinometer plane is cut on the top of the cradle on the right side.

HYDRAULIC BUFFER AND AIR CYLINDER.

(Plate XIII.)

The hydraulic buffer consists principally of a steel cylinder with stuffing-box and glands, piston and rod, valve key and controlling plunger.

The *buffer cylinder*, which also forms the ram of the air cylinder, is closed at the front end by a leather washer, large gland, L-leather, stuffing-box, greased packing and small gland. The cylinder is connected to the gun by means of the "Band connecting gun and buffer." A steel feather let into the cylinder and band underneath prevents the cylinder turning. The cylinder is fitted with an air plug on its top front end and with a filling and emptying cock on its underside immediately below the air plug.

The *piston, including rod*, is of steel, bored out to form a chamber for the controlling plunger. A hole is also bored from the control chamber to the end of the rod to release the air from the chamber when the buffer is being filled, the end of the rod being fitted with a manganese bronze plug. Should it be necessary to withdraw the piston from the cylinder the plug must be removed and the lifting eye No. 2 inserted. Two bronze rings are fitted round the piston to prevent scoring. A port for the valve key is cut through the piston. The piston rod is connected to the front transom of the cradle by a screwed collar in rear and a nut and keep pin in front.

The *valve key* is of manganese bronze. It is secured in the inside of the buffer cylinder and is formed to fit the sides of the port, but varies in thickness and thus regulates the flow of liquid from one side of the piston to the other to equalise the pressure during recoil.

The *controlling plunger* is a steel rod tapered at the point. A flat is formed along the surface for the escape of oil over it when running out.

The *air cylinder* is divided into two chambers by a diaphragm. The rear end of the buffer cylinder passes into the front chamber through a stuffing-box or liquid gland packed with greased packing and with a perforated ring where the intensifier liquid lies.

The rear chamber contains a perforated tube, which carries a valve at its front end to bear against an opening in the diaphragm and prevent the compressed air running the gun out too violently; the tube at its rear end has two screw nozzles, one for the connection of the pressure gauge and the other for the pump used in filling; both channels can be closed by a screw valve.

The *intensifier* consists of a cylinder cast in the rear chamber of the air cylinder; it contains a piston fitted with cup leathers each side and has a rod attached which projects through a stuffing-box in rear.

The front portion of the intensifier cylinder is connected by a small hole with the air cylinder, so that the pressure of air can act on the

front of the piston. The rear portion of the intensifier is connected by a pipe with the liquid gland and all these parts are full of liquid. As the area of the piston exposed to pressure by the air is greater than the area exposed to liquid, the pressure per square inch of the liquid gland is always greater than that of the air trying to escape past it and so the escape of air is sealed.

To charge the intensifier, see page 72.

Leakage at the intensifier.—The intensifier requires refilling when the rear of its piston rod is about flush with the rear end of its gland. A special clamp may be used to force in the piston rod and so suck more liquid in through (N) from a special funnel, but it cannot be used for initially filling.

The clamp consists of a cross-piece which can be secured when required, by two bolts to holes in the rear end of the air cylinder. A screw works through the cross-piece and can be forced against the piston rod by means of the spanner.

A small air pump attached to the carriage may be used for charging the air cylinder.

Action.—On recoil, the gun, bands with sliding bars and buffer cylinder recoil together. The buffer cylinder is drawn off the piston rod; the liquid passing from one side of the piston to the other through the port, checks the recoil, assisted by the resistance of the compressed air in the air cylinder. As the buffer cylinder recoils it forces air through the diaphragm valve and compresses it into the rear chamber at a pressure about three times the initial pressure.

On completion of recoil the diaphragm valve shuts, the air expands and, entering the inner air chamber through the small hole in the head of the valve, pushes the buffer and gun up into the firing position. The action of the controlling plunger displacing the liquid in the piston rod brings the gun quietly to rest.

CARRIAGE.

The carriage is of steel, consisting of two built-up sides of plates and angles; castings are riveted on to the outside forming cradle trunnion bearings and bearings for the supporting screws of the cradle ball-bearings. Steel capsquares screwed down secure the cradle in its bearings. The sides are connected by two front, two rear and two intermediate transoms. Two box transoms are also fitted to the underside of the carriage, one front and one rear; to these transoms an upper roller path is fitted. The carriage is connected to the pivot by two plates, one fitted between the box transoms, the other at right angles; a metal bushed hole in the centre fits the pivot plug. Front and rear clip plates are bolted to the carriage and engage under the outer flange of the pivot plate. A stop to limit elevation is secured at the rear transom.

Wood covers are provided to keep out dirt and grit from the live roller ring.

ELEVATING GEAR.

(Plate XIV.)

The gear consists generally of worm and bevel wheel gearing, working two arc pinions which gear with the elevating arcs on the cradle. The gear is actuated by handwheels from the sighting platforms or from the floor of the pit on the left side; the latter is slightly the quicker gear.

The elevating arcs are bolted to the underside of the cradle sides, the arcs being connected and strengthened by a cross transom bar.

The shaft carrying the arc pinions also carries a steel worm-wheel on its outer end at the right side of the carriage; the worm-wheel is in gear with a worm on the worm (third-motion) shaft; this shaft works in metal bearings and to reduce friction in these bearings an anti-friction roller ring is fitted on each side of the worm. The worm-shaft is in bevel gearing with the vertical (second-motion) shaft; the vertical shaft has on its upper end a bevel wheel gearing with a pinion on the (first-motion) shaft, which is actuated by a handwheel.

The gear on the left side, first-motion and second-motion, is similar to that on the right side. The right and left side gears are connected by a cross-shaft and mitre gearing with the vertical (second-motion) shaft.

The gear as worked from the floor of the pit is a continuation of the vertical (second-motion) shaft on the left side and gears with a shaft actuated by a handwheel having a folding handle.

To prevent damage to the teeth of the worm gearing on shock of discharge the worm-wheel is only attached to its shaft by friction plates. These plates are alternately of steel and gunmetal and are connected to the shaft and the worm-wheel. They are jammed together through the medium of two jamming plates, a spring disc and two steel nuts. The nuts are tightened up so that, ordinarily, friction causes the worm-wheel and its shaft to turn together, but on shock of discharge the shaft can turn a little inside the worm-wheel.

It was found that the gun had a tendency to elevate right up on firing and so a brake has been fitted to act on the rim of the upper elevating handwheels; the brake is operated by a foot lever from the sighting platform, or by a handrope from the shell pit near the lower elevating handwheel.

TRAVERSING GEAR.

(Plate XV.)

The gear consists generally of spur and bevel wheel gearing working a rack pinion at the front of the mounting; the rack pinion gears with the traversing rack. The gear is actuated by handwheels practically from the same positions as the elevating gear. The upper handwheels work the slow-motion gear and the lower the quick-motion.

The rack pinion fits on a shaft working in bearings in the box transom of the carriage; this shaft carries a spur wheel which gears with a spur pinion on the intermediate shaft and has a spur wheel on its upper end in gear with a spur pinion on the vertical (second-motion)

shaft; the vertical shaft has on its upper end a bevel wheel gearing with a pinion on the (first-motion) shaft, which is actuated by a hand-wheel having a folding handle.

The gear on the left side, first-motion and second-motion, is similar to that on the right side. The right and left side gears are connected by a cross-shaft gearing with the vertical (second-motion) shaft.

The gear as worked from the floor of the pit is a prolonged vertical (second-motion) shaft in mitre gearing with a shaft actuated by a hand-wheel having a folding handle.

Stops are provided so that practice may be kept within safe lateral limits except for such carriages as are fitted with a rotating exhaust joint as well as with an "Apparatus, traversing, position-finding dials."

Carriages which are served by a P.F. are fitted with pointers having deflection scales to indicate a deflection of 3° right or left independently of the angle of traverse ordered; the degree scales are divided into divisions of $10'$. Each pointer consists principally of a bracket which carries a screw with a nut and a scale plate; the nut is formed with two projections, one of which indicates the amount of deflection on the scale plate and the other the angle of traverse ordered on the traversing arc.

ELEVATION INDICATOR GEAR, MARK II.

(Plate XVI.)

The *Mark II* elevation indicator gear consists of an arc which is attached to the front of the elevating arc on the left side. Into the arc gears a pinion on a cross-shaft which is supported in bearings on the carriage bracket.

Over the outer end of the cross-shaft is fitted a spring barrel, which in turn carries a cam to which a yard scale plate is attached by screws and a feather. The full charge scale plate will be engraved on the reverse side with a scale for use with 2 c.r.h. projectiles with three-quarter charges. Magazine temperature and M.V. scales for this charge must be fitted and full charge ones temporarily removed. The plate is graduated spirally in yards of range, the graduations being read by a pointer which fits loosely over the end of the spring barrel. The pointer is formed by a bracket which at its upper end has a collar to fit the spring barrel on the inside of the cam and two guide bars having a hinged collar at their upper ends which fits over the spring barrel outside the cam, the bracket and guide bars being connected at their lower end. The guide bars carry a M.B. reader with arrow to read the graduations on the yard scale plate and a spring plunger to work in a spiral groove cut in the outer face of the cam in order that the reader may conform to the spiral graduation on the plate. A recess is cut in the reader to expose the graduations on the plate.

Pivoted to the outer supporting bracket is a steel cam lever which at one end carries a stud to work in a cam groove cut in the inner face of the cam, while its other end carries a M.V. scale strip and also has two dovetailed grooves, in one of which slides a charge temperature scale strip and in the other a reader for the latter. This reader is carried on one end of an actuating link, the other end of the link being pinned to a lug on the top of the pointer-bracket.

To prevent backlash between the arc and pinion a clock spring, held in position by a plate, fits over the shaft and has one end attached to a stud on the spring barrel, while the other end is attached to the outer bearing.

By means of the above scales a correction can be made to the gear to correct for variations from normal muzzle velocity as found by calibration, the shape of the cam groove being such as to ensure the correction being a true one at all ranges.

Mark II elevation indicators are provided with a separate yard scale plate for use with 1-inch A.R. and 6-Pr. S.C. It consists of a steel plate with zinc discs soldered on each face. One face is graduated in yards for 1-inch A.R., the other face for 6-Pr. S.C. The plates should be graduated locally. In fitting the plate to the indicator the full charge plate will have to be removed and the new plate fixed similarly in position.

Yard scale plates for the elevation indicator of carriages mounted on low sites, are made of xylonite.

SIGHTS AND SIGHTING GEAR.

Parallax of Sights.

Mark of Gun.	Mark of Carriage.	Automatic sight.		Rocking-bar sight with telescope horizontal.	
		Axis of telescope above gun axis.	Axis of telescope right or left of gun axis.	Axis of telescope above gun axis.	Axis of telescope right or left of gun axis.
"C" IX	V _A & V _B	inches. 20.15	inches. 46.6 right	inches. 22.55	inches. 46.9 left
X & X*	VI & VI _A	24.65	46.6 right	28.05	45.3 left
X & X ^v	V	24.65	46.6 right	27.05	46.9 left

Automatic sights.—Full description is given in the Treatise on Military Carriages.

Instructions for changing cams.

In changing cams the following instructions will be observed :—

1. Place the gun at about 1° elevation.
2. To remove the spring case, remove the pin and collar from the studs carrying the spring case and remove the spring case from studs.
3. Unscrew the nut on the threaded end of the "Pivot, lever, cam roller," until its outer face is flush with the threaded end of the pivot, then slide the lever out on its pivot as far as it will come.

4. Remove the keep pin and nut from the cam stud and the keep pin from the "Stud, lever, adjusting, cam." Remove the thumb nut and clip from the "Lever, adjusting cam."
5. Remove the cam out towards the right, facilitating its removal by moving the adjusting lever up and down.
6. To mount the required cam with its adjusting lever the order of the instructions detailed above is reversed. Care must be taken that the cam roller and driving edge of the cam are clean.
7. After changing a cam adjust the sight.

ROCKING-BAR SIGHT.

(Plate XVII.)

This gear is fitted on the left side of the mounting and consists principally of a sight bar, rocking-bar and carrier, the whole being secured to a metal bracket fitted to the front of the cradle.

The *sight-bar* is a steel tubing pivoted vertically to the front end of the rocking-bar so as to admit of horizontal movement for deflection; the front end is fitted with an acorn-pointed foresight, also a sighting blade on a hexagon at the front of a turning rod within the bar; the rod is secured by a nut and screw; the blade can be turned down when necessary by a thumbpiece at the rear end of the bar; a special spiral spring retains the blade in position. At the rear end of the sight-bar is fitted two holders and hinged caps for securing a sighting telescope, also a lug in which is formed a V notched leaf for use as a hind-sight.

The *rocking-bar* is pivoted horizontally to the carrier so that the rear end may be raised or lowered according to the range; the pivot of the sight-bar is formed at the front end; to the underside of the rear end is attached a toothed arc to gear with a pinion on the carrier; on the rear face of the arc is a scale graduated in degrees; the rear end is formed with a crosshead having a deflection screw with milled head; the screw works in a nut which moves the sight-bar to the right or to the left. The amount of deflection is indicated by a scale plate and arrow head. The space between each of the markings is equal to 10'; the total deflection is 2° right and left.

The *carrier* is of steel and is secured to the arm of the supporting bracket; the rocking-bar is pivoted to the front end and the rear end is fitted with a worm and worm-wheel gearing; the worm is mounted on a spindle having an actuating hand-wheel at its rear end; to the spindle of the worm-wheel is fixed a pinion which gears with the teeth of the arc on the rocking-bar, also a drum on which is mounted a detachable yard scale ring. Zinc rings, to be graduated locally from results obtained by calibration, are provided.

Compensation for drift for full and three-quarter charges is provided for, partly by the construction of the sight, which causes the rocking-bar and sight-bar to move through an angle of 3° left inclination to the vertical plane when the sight is elevated or depressed and partly by the sight-bar being set with a permanent angle of 6½' right deflection; the

combined effect of these two combinations gives a very close correction for drift at all ranges. A red line marked "True zero" is engraved on the deflection scale plate and denotes the zero to be used when testing the sight.

For the convenience of the layer an adjustable shoulderpiece is provided. The stock is of walnut wood, with an elastic pad formed of a length of indiarubber tube, which has its upper end protected by a brass cap secured to the stock by screws.

TELESCOPES, SIGHTING, FOR ROCKING-BAR AND AUTOMATIC SIGHTS.

The following telescopes can be used :—

No. 1 ...	...	...	...	Marks I, I*, II and III.
No. 3 ...	...	...	...	Marks I and II.
No. 7 ...	...	...	...	Mark I.

TELESCOPE, SIGHTING, No. 1.

Particulars.

Magnification	...	...	...	3-diameters.
Field of view	...	...	...	10-degrees.
Length over all	...	...	...	24-inches.
Weight	...	...	...	7-lbs.

Mark I telescope is of the ordinary erecting type with an object glass and terrestrial eyepiece.

The body is fitted with two long gunmetal collars which accurately fit the bearings on the sight-bar, but allow 3-inches of movement backward or forward to suit the convenience of gun layers.

The eyepiece is fitted with a fixed dermatine eyeguard.

A diaphragm carrying a diamond-shaped pointer having a blunted tip is fixed between the third and fourth lenses of the eyepiece.

The object-glass is fitted in an eccentric cell and ring and is fixed in the correct position for infinite focus, or, in other words, for all objects over 400 yards distant. It is protected by a ray shade and metal cap.

*Mark I** telescope differs from *Mark I* in having a detachable dermatine eyeguard.

Mark II telescope differs from *Mark I** in having improved focussing arrangements. The turning movement of the eyepiece can be read off an engraved ring, numbered 0 to 7 in conjunction with an arrow on the body, 4 being the position for normal vision, so that individual layers may set their focus to the figure previously determined.

The pointer is fixed at the focal length of the object-glass.

Mark III telescope differs from *Mark II* in the diaphragm, which carries the pointer, being made adjustable so that collimation may be carried out by means of the diaphragm instead of by rotating the object-glass in eccentrics.

TELESCOPE, SIGHTING, No. 3.

Particulars.

Magnification	...	...	...	...	10-diameters.
Field of view	...	...	...	...	3½-degrees.
Length over all	...	...	...	...	24·5-inches.
Weight	...	...	...	...	7-lbs.

Mark I telescope is generally similar in construction to No. 1, *Mark II*, but differs in having a triangular shaped pointer.

No. 3, *Mark II* telescope differs from *Mark I* in the diaphragm, which carries the pointer, being made adjustable by four screws, as in No. 1, *Mark III*.

To focus the telescope :—

No. 1, Marks I and I*.—Screw the eyepiece in or out until the pointer is clearly defined.

No. 1, Marks II and III and No. 3, Marks I and II.—Revolve the eyepiece tube by means of the knurled ring to the graduation required.

Collimation.—Lay the tip of the pointer on a well-defined point some distance away, the further away the better and turning the telescope completely round in its bearings the tip of the pointer should remain on the distant object if correct for collimation.

TELESCOPE, SIGHTING, No. 7.

Particulars.

Magnification	...	...	...	...	5 to 21-diameters.
Field of view	...	...	...	...	6° to 1° 15'.
Length over all	...	...	...	...	31·5-inches.
Weight	...	...	...	...	8·25-lbs.

This is a variable power telescope with a steel body in place of bearing bands. By revolving the eyepiece end the magnification can be altered from 5 to 21 diameters without throwing the telescope out of focus. The telescope is fitted with a blunted chamfered pointer.

Collimation.—The diaphragm is placed inside the eyepiece adapter. To adjust the collimation it is necessary to remove the eyepiece as follows :—

1. Unscrew the set screw between eyepiece body and eyepiece adapter and unscrew the eyepiece body.
2. Lift out the diaphragm stop. This uncovers the diaphragm and the four cone-headed collimating screws.

Collimate in the usual way and reassemble the telescope.

ELECTRIC FIRING GEAR.

(Plate XVIII.)

The gear is arranged on the mounting so that the gun can be fired from either sighting platform or below the pit shield.

It consists of a battery with connections, three pistol grip connectors, a pistol grip, junction box, sliding contact and a series of cables.

The battery consists of four "Cells, electric, inert, A," which stand on strips of rubber in a galvanised box separated from each other by a strip of felt, and are connected up in series.

A cable positive pole is attached to the positive pole of battery and led through a hole in the box to a connection cable to battery box, from which the current is distributed by cables to the several pistol grip connectors. A copper strip connects the negative pole of the battery with the outside of the battery box. A terminal earth return is also secured to the battery box to which one end of the L lead is attached, the other being attached to the mounting.

The *pistol grip connectors* are each similar in pattern; one is secured to the holder on the right side of the carriage, another to the socket formed in the shoulderpiece pintle and a third on the side of the carriage in such a position that the pistol grip can be manipulated from the floor of the work. Each connector is formed for the contacts on the pistol grip. Each contact is insulated and prepared for the reception of a cable. The pistol grip is secured in position by a clamping screw and a cover is provided to prevent the ingress of dirt, &c., into the recess for the pistol grip.

The *pistol grip* is used to test the tube and circuit immediately before firing and for firing the tube. The *Mark III* consists of a firing key and indicator in a metal case. The firing key is in the form of a trigger with a contact lever in the handle, the function of which is to close the circuit through the indicator by means of a plunger.

The *indicator* consists of an electro-magnet enclosed in a case with glass window and cover at the rear end, and is constructed to show alternate segments (painted black) of the indicator disc.

NOTE.—*Mark V* pistol grips must be used with the *Mark III* connector pistol grip.

Action.—When a tube is in the gun or the needle of the striker earthed, by depressing the contact lever of the pistol grip, the circuit through the indicator is completed and the sectors should be shown; by pulling the trigger the indicator is cut out of the circuit and the tube fired.

The *junction box* serves as a connector for the cables from the pistol grip connectors and sliding contact.

The *sliding contact boxes*, plate and plug are contained in brackets, the former being attached to the right sliding bar on the gun and the latter to the cradle; the plate box contains a rubbing plate, insulated and prepared for the attachment of a cable; the plug box, an insulated spring plug having a suitable connection for the "A" cable. A releasing lever is attached to the plug contact box by which the circuit can be completed when it is required to fire the gun. The contacts are so arranged that when the gun is fired the circuit is broken and remains so until completed by hand when ready to fire. This is done to keep the control of fire in the hands of the gun captain, who does not complete the circuit till the rear hoist is clear of the gun in recoiling.

Cables, Expendable.

Designation.	Position of Cable and Colour.	B.L. 9·2-inch barbette.			Ref. letters.
		IV.	V to VB.	VI and VIA.	
With 2 hook contacts—					
207-inches ...	Gun to sliding contact. White	{ 1	—	—	A
104-inches ...		{ —	1	1	
With 2 loop contacts—					
257-inches ...	Sliding contact to junction connector or box. × Purple	{ —	—	1	B
221-inches ...		{ —	1	—	
114-inches ...		{ 1	—	—	
13-inches ...	Battery box to carriage (earth return). Black and white alternate ...	1	1	1	L
With 2 loop contacts or 1 hook and 1 loop contacts†—					
228-inches ...	Right-hand pistol grip connector to junction connector or box. Red	{ 1	—	—	C
177-inches ...		{ —	—	1	
141-inches ...		{ —	1	—	
234-inches ...	Right-hand pistol grip connector to battery. Yellow	{ 1	—	1	D
196-inches ...		{ —	1	—	
114-inches ...	Left-hand pistol grip connector to junction connector or box. Black	{ —	—	1	E
77-inches ...		{ —	1	—	
60-inches ...		{ 1	—	—	
150-inches ...	Left-hand pistol grip connector to battery. Light brown	{ —	—	1	H
114-inches ...		{ —	1	—	
68-inches ...		{ 1	—	—	
96-inches ...	Lower pistol grip connector to junction connector or box. Blue	{ 1	—	—	J
52-inches ...		{ —	1	1	
85-inches ...	Lower pistol grip connector to battery. Green	{ 1	—	—	K
44-inches ...		{ —	1	1	

† When fitted with *Marks I** or *II* pistol grip connector these cables are provided with two loop contacts, but when fitted with *Mark III* connector the cables have 1 hook and 1 loop contact.

SHIELDS.

Four steel shields are provided. They are: Shell-pit shield, front shield and two side shields.

The *shell-pit shield* is for the protection of the shell-pit. It also answers the purpose of a platform, from which the sighting platforms are reached and loading, &c., is attended to. It consists of cantilevers made up of plate and angle steel, supported by knee brackets fixed to the carriage; steel plates are riveted on top of the girders to form a platform. A grating is provided on each side in front and openings in rear for the projectile hoist and loading gears, for which there are hinged cover plates or doors. The opening between the doors for the

rear hoist is covered by flaps, which are opened and closed automatically by the hoist. Guards are fitted on the upper portion of the outer ram to prevent the flaps fouling the tray when being lowered. These hinged doors with flaps must be opened wide when firing at high angles of elevation to allow the gun to recoil free of the shield and at the same time a pin in the side of the carriage limiting elevation is removed (*see instruction plate on the carriage*). Plates of sheet lead are fitted on the top of the shield in order to give the numbers working the gun a secure foothold. Where portions of the lead have been removed the surface is roughened.

A sighting platform is erected at each side of the carriage on top of the shield.

The *front shield* is made in halves and fitted together when in position by a steel butt plate and screws on the inside. The shield is winged to the rear and splayed outwards at the bottom. It stands on the shell-pit shield and is secured to the carriage by steel elastic stays with disc springs. The front is cut away to suit the gun and also for the sights. Two steel stops to limit depression are secured to the stays carrying front shield.

The *side shields* are secured to the carriage by steel elastic stays and disc springs. They are on top of the shell-pit shield. The right-hand side shield is fitted with a bracket to carry "Boxes, tube, garrison."

LOADING ARRANGEMENTS.

The loading gear consists principally of a steel arm with loading tray, spring accumulator with valves, front and rear hoist and projectile trollies. As an auxiliary arrangement a derrick with windlass and tackle is provided.

The *steel arm* is bolted to a projection on the left rear of the cradle; the outer end is prepared for a joint pin upon which the tray pivots. The tray is of metal connected to the steel arm by a joint pin. It is provided with two locking catches, which secure it in the required position. A steadying holder is provided to engage a corresponding hole in the left face of the bronze end frame of the gun for supporting the tray when in the loading position. The tray is intended to protect the screw threads in the breech of the gun while the projectile is being rammed home. After the cartridge is loaded the projectile tray is swung back.

Hydraulic gear (Plate XIX).—By means of compressors on the cradle some of the energy of recoil is utilised to store up liquid under pressure in a spring accumulator for working the hoists of the loading gear.

The compressors are connected by means of a gun pressure pipe to a spring accumulator, fitted with a tank installed in the work, which in turn is connected by accumulator pressure and exhaust pipes to the valves controlling front and rear hoists.

The compressor cylinders are provided with rams, which are connected to the band on the gun, so that when the gun is fired the rams are driven in and the liquid in the compressors is forced through the gun pressure pipe and non-return valve into the accumulator,

causing the springs of the latter to be compressed and consequently storing up the liquid under pressure for the working of the hoists.

As soon as the guns run up again a vacuum is created in the compressors. The liquid is drawn through a suction valve from the tank and gun pressure pipe to the compressors, thereby charging them for the next round.

A relief valve is fitted to the tank to meet the possibility of the gun being fired when the accumulator is in such a state of compression that there is not room for the liquid from the compressors to enter the centre cylinder of the accumulator. When this occurs the valve opens and discharges the liquid into the tank. The spring is sufficiently strong to keep the valve closed under ordinary conditions.

The pressure to the hoists is controlled by control valves actuated by lever handles and the liquid in the hoist cylinders, when the ram descends after raising a projectile, is allowed to escape through an exhaust pipe back to the tank of the accumulator.

A pump is provided to obtain the initial pressure in the accumulator or to restore the loss of pressure in the compressors.

The chequered plate immediately over the accumulator pump is fitted with two steel stops with bolts to limit the stroke of the accumulator pump lever.

A syphon is provided for reducing, as required, the quantity of liquid in accumulators.

The *hoists* are "Front" and "Rear" respectively.

The hoists are provided with rams, the top of each being fitted with a bearer for supporting the projectile. The front hoist is fixed in the floor of the emplacement and is used to raise projectiles from the barrow to the trollies on the circular railway. The front hoist may be worked at any time, so that two or three projectiles may be ready to run over the rear hoist.

The *rear hoist* is secured to the rear of the mounting and moves with it and is used to raise projectiles from the trollies to the loading tray. The rear hoist tray is fitted with a lanyard which can be hauled upon to facilitate the lowering of the ram and is cut to clear the automatic catches of the projectile trollies.

Projectile trollies.—Six projectile trollies are provided. Near the rim of the shell-pit shield is a flange of sufficient depth to admit of the projectile trollies running on top of its inside flange, termed the outer rail; an inner rail with a similar flange is fixed to the girders of the shield by knee brackets. A short length of the inner rail is made removable at the rear by being secured with bolts and nuts instead of rivets, so that the trollies may be removed when required.

The trollies are for carrying the projectiles on their sides from the front hoist of the pit to the loading position or rear hoist. Each consists of a steel frame mounted on four flanged rollers, with a clip plate at each end. A wood buffer or striking block, furnished with a rope handle, is bolted on to each side of the frame and a wood housing block and a pair of steel hinged bearing straps with automatic catches and locking keys secure the projectile in transit. The outer clip plate of the trolley has a groove to engage two spring catches, which secure the trolley in a position suitable to the hoists. That for the front

position is on an arm secured to the parapet of the work and the other fixed to a bracket on the outer rim of the shield.

With this gear the projectile is brought in a barrow over the tray of the front hoist. A reversible steel plate is fitted to the covering plate of the hoist to indicate the holes in which the feet of the barrow should be placed for each nature of two or four calibre radius-headed shell. The hoist is worked and the projectile is raised to and secured in the projectile trolley, which is run round to the rear hoist, to which the projectile is transferred and raised to the loading tray, the tray being swung into the breech chamber before the shell is raised.

The gun may be loaded at 5° elevation or 5° depression in any position of traverse.

The derrick gear.—The derrick is made of two steel curved plates, connected by collar bolts and secured to a pivot piece by screws. The jib plates are in two parts and connected by joint plates, so that the upper portion can be folded down when the derrick is not in use. When folded down the derrick is supported in a bracket fixed to the left side shield; the bracket is fixed in such a position that the bracket supporting loading arm on the cradle will clear the derrick at all angles of elevation and depression. The pivot piece is provided with two bearing surfaces, which fit into corresponding metal bushes in the lug of a steel bracket at the left rear of the carriage. It is fitted for a fall of steel wire rope $44\frac{1}{2}$ -feet long, with a sheave block with hook and thimble. A shackle and three gunmetal guide sheaves are fitted to the plates of the derrick. One end of the wire rope is spliced to the shackle at the top of the derrick, the other end is rove through the sheave block, over the guide sheaves, down through the hole in the pivot piece of derrick and then spliced to the thimble, which is secured to the windlass drum by a pin.

The windlass consists of a cast-iron drum with a ratchet and band brake and a spindle with a winch handle. It is attached to the underside of the rear box transom of the carriage immediately below the derrick by means of cast-iron brackets.

When using the derrick, the projectile is brought to the rear of the carriage in a barrow and then raised from the pit through an opening in the shell-pit shield to the loading tray, which is then swung round to the breech of the gun.

When 6-pr. sub-calibre guns are fixed to the mountings the derrick, when housed, should rest on the sighting platform. Care must, however, be exercised in lowering the derrick.

During practice from the sub-calibre gun the derrick should be erected.

PEDESTAL, CARRIAGE, No. 4.

This pedestal is the same as that described for *Mark IV* mounting, see page 38. It is used with the *Mark V* mounting at Dover.

PEDESTAL, CARRIAGE, No. 7.

This pedestal is a hollow iron casting, cast in halves and bolted

together by means of junction plates and bolts when the pedestal is placed in position. The top and inside surfaces are prepared to take the pivot plate.

The pedestal is secured to the work by the holdfast and is used with *Marks V to VI A* except *Mark V* at Dover.

HOLDFAST, CARRIAGE PEDESTAL, No. 4A.

The holdfast is of steel and consists of 13 anchoring plates and 52 holding down bolts, which are 9-feet 11-inches long, each having a cotter. The bolts are nutted to the bottom flange of the pedestal and embedded with the anchoring plates in concrete.

Weight, 4-tons 10-cwt.

It is used with *Marks V to VI A* carriages.

PLATE, PIVOT, No. 4 CARRIAGE PEDESTAL.

The No. 4 pivot plate is of steel with racer and traversing rack and fixing screws. It is used on No. 4 pedestal.

PLATE, PIVOT, No. 7 CARRIAGE PEDESTAL.

This is of steel, cast to shape and fitted on top of the pedestal by bolts on either side of racer. There are 30 bolts on the outside and 16 on the inside of the racer. In the centre of the plate there is a hole having a shoulder to suit the pivot plug. There is a flange on the underside to take a bearing against the inside face of the pedestal, while another flange, cast on the outside rim, gives a bearing to the clip plates of the carriage.

A segmental traversing rack is secured above the clip plate flange of the plate by screw bolts.

It is used with *Marks V to VI A* carriages.

PLUG, PIVOT, No. 19.

The pivot plug is of steel, with securing plate and screws. The plug has a flange to take a bearing on the shoulder of the hole in pivot plate and in the bush of the carriage. It is prevented from turning by a steel feather let into a featherway. The plug is prepared for the pipes of the hydraulic gear, and is for use with Nos. 4 and 7 pedestal pivot plates.

ARC, TRAVERSING, No. 3A.

Mark I.—This arc is of brass made in two ring sections, each being in lengths. The degree figures are engraved upon the upper section and the divisions and sub-divisions on the lower one. It is secured round the outer face of racer below the clip ring. The angle of traverse is indicated by a pointer fixed to the carriage. Radius, 5 feet 1.442 inches. Weight, 2-qrs. 4-lbs.

It is used with *Marks V to VI A* carriages.

Note.—*Inscription plates are fitted to carriages, shell-pit shield, side shields, pivot plate and carriage pedestals to facilitate identification.*

WEIGHT AND HEIGHT OF EQUIPMENT.

Weight Carriage on racers, 74-tons, 17½-cwt.
 Height Axis of gun above racer in firing
 position, 6-feet 11.35-inches.

CARRIAGES, GARRISON, BARBETTE, B.L. 9.2-INCH,
MARKS VA AND VB.

A certain number of B.L. 9.2-inch *Mark V* barbette carriages have been modified to adapt them for use with B.L. 9.2-inch "C" *Mark IX* guns. When so modified the letter "A" or "B" will be added to the Mark of the carriages.

Mark VA Carriage.—The modifications generally include special attachments for securing the gun in the cradle, a new pattern loading tray, loading arm and valve key. The gun attachments consist of a saddle, which is clipped to the gun by two bands connected by a tie-bar and formed to suit the lower portion of the cradle and two sliding blocks which are connected to the gun by a "Band, connecting gun and buffer," and by the trunnions of the gun. The guide clips for securing the sliding blocks in the cradle are of a special pattern.

A spanner, No. 286, for use with the pawl of the loading tray, a suitable cam for the automatic sight, a yard scale ring for the rocking-bar sight and a carrier for the sliding contact of the electric firing gear are provided.

The *Mark VB* carriage differs from *Mark VA* in the pattern of the lower half of the "Band, connecting gun to buffer," in the design of the loading tray and in the arrangement for carrying the sliding contact of the electric firing gear.

In the event of it being required to mount a *Mark X* gun on any of the above-mentioned carriages it will be necessary to remove the guide clips from the cradle and the cap from the lower half of the "Band, connecting gun to buffer," when the "C" *Mark IX* gun can be readily removed from the cradle and the *Mark X* gun with its attachments mounted. The guide clips of the cradle, valve key, loading arm, loading tray, yard scale plate of the elevation indicator gear, yard scale ring of the rocking-bar sight and the cam for the automatic sight, will be replaced by those suitable for use with the *Mark X* gun.

CARRIAGE, GARRISON, BARBETTE, B.L. 9.2-INCH,
MARKS V TO VB.*List of Lubricating Holes.*

Articles.	No. of Holes.	Remarks.
Hinges of doors, shell-pit shield (4) each	1	Accessible from top of shield.
Trolleys, projectile (6) each	4	One in each bracket carrying axle and roller, accessible from top of shell-pit shield through the doors.

List of Lubricating Holes (continued).

Articles.	No. of Holes.	Remarks.
<i>Above shell-pit shield.</i>		
Bearings, ball trunnion (2) ... each	1	In retaining nut.
Brackets, cross-shaft—	—	These brackets, which are not capped, are situated at the front of the carriage; a small quantity of oil should be applied where the shafts take bearing.
Elevating centre...		
Traversing centre ...		
Left side—		
Bracket—		
Arc pinion shaft, left...	1	
Cross and vertical shaft—		
Elevating, left ...	2	One for vertical shaft and one for cross-shaft.
Traversing, left ...	1	For cross-shaft; also a groove in bearing for vertical shaft.
Elevating and traversing gear, left, upper ...	4	One in each bearing for hand-wheel spindles.
Supporting elevation indicator, outer ...	1	
Capsquare, left ...	1	The tapped hole for lifting eye.
Clips, guide, cradle, left ...	8	For lubricating sliding surfaces.
Derrick, loading ...	4	In shoulder of derrick post, communicating with upper bearing and each guide sheave.
Tray, loading ...	2	One in each bearing for lubricating loading arm.
Wheels, bevel, vertical shaft—		
Elevating gear, upper ...	1	Through boss of wheel conveying lubricant to shaft bearing; accessible through cover of guard.
Traversing gear ...	1	
Right side—		
Bracket—		
Arc pinion shaft, right ...	2	In upper bearing for lubricating anti-friction worm bearings; also a lubricating pipe conveying lubricant to shaft; accessible through hinged door of right-hand sighting platform.
Cross and vertical shafts—		
Elevating, right ...	2	One for worm-shaft and one for cross-shaft.
Traversing, right ...	1	For cross-shaft; also a groove in bearing for vertical shaft.
Elevating and traversing gear, right	3	One in each bearing for hand-wheel spindles.

List of Lubricating Holes (continued).

Articles.	No. of Holes.	Remarks.
Right side— <i>continued</i> —		
Bracket— <i>continued</i> —		
Worm-wheel spindle gear correcting auto-sights	2	One in each bearing
Shaft, rack pinion	1	In upper end of shaft
Wheel, spur, intermediate shaft, tra- versing gear	1	In boss of wheel conveying lubricant to shaft bearing
Capsquare, right... ..	1	The tapped hole for lifting eye.
Clips, guide, cradle, right	8	For lubricating sliding surfaces.
Wheels, bevel, vertical shaft—		
Elevating gear, upper	1	Through boss of wheel conveying lubricant to shaft bearing; accessible through cover of guard.
Traversing gear	1	
<i>Under Cradle.</i>		
Brackets, arc pinion shaft, centre	1	
Bracket, supporting elevating indicator, inner	1	On inside left carriage bracket.
Carriage body	—	Four oil grooves, in centre pivot bearing, for lubricating pivot plug.
<i>Below shell-pit shield.</i>		
Roller ring, axles (26) each	1	In head of axles; accessible from right side and left side, but to lubricate all the axles the mounting must be traversed.
Left side—		
Bracket—		
Elevating and traversing gear, left, lower	2	One in each bearing for horizontal shaft and both bearings for vertical shaft, cupped to receive oil.
Loading derrick	—	Lower bearing cupped for oil.
Loading windlass	2	One in each bearing for drum spindle.
Lever counter-weight, loading windlass	1	For axis pin.
Right side—		
Pump, air	1	In cylinder, for lubricating plungers and slide for rocking lever.
Pinions, spur, traversing gear—		
Intermediate shaft	1	In boss of pinion
Vertical shaft	1	In boss of pinion
Wheel, spur, rack pinion shaft	1	In boss of wheel
		Conveying lubricant to shaft bearings, accessible through hinged door of gear cover.

NOTE.—In addition to the foregoing, all working parts, *e.g.*, joints of levers, catches, &c. (where lubricating holes are not provided), should be occasionally oiled.

SPANNERS AND SPECIAL IMPLEMENTS.

(MARKS V, VA AND VB MOUNTINGS.)

Clamp, adjusting intensifier piston.

Pipe, filling intensifier (with funnels).

Spanners :—

No. 1 ...	...	For gland, intensifier.
No. 51 ...	...	For filling and emptying valve connection, &c.
No. 98 ...	...	For valve filling and emptying, &c.
No. 203 ...	...	For filling and emptying valve, gland, air cylinder.
No. 206 ...	...	For tube, gland, or piston rod plug.
No. 208 ...	...	For plug, outer air cylinder.
No. 209 ...	...	For nut, adjusting trunnion ball-bearing ring.
No. 211 ...	...	For bolts, securing elbow pipe, &c.
No. 212 ...	...	For nuts, arc pinion shaft.
No. 213 ...	...	For stuffing-box, rear hoist.
No. 214 ...	...	For cap, cylinder, rear hoist.
No. 215 ...	...	For plug, cylinder, front hoist.
No. 216 ...	...	For gland, centre pivot pipe.
No. 217 ...	...	For gland, pipe bend centre pivot.
No. 218 } No. 219 }	...	For accumulator, valve seatings.
No. 220 ...	...	For glands, plunger, accumulator pump.
No. 221 } No. 222 }	...	For tightening trench pipe joints.
No. 223 ...	...	For nut, securing elbow pipe, cradle trunnion.
No. 224 ...	...	For coupling connecting pipe, accumulator pump.
No. 225 ...	...	For 3·546-inch nuts, holdfast, carriage pedestal.
No. 226 ...	...	For 3·17-inch joint plate bolts and nuts, carriage pedestal.
No. 227 ...	...	For glands, compressor, charging accumulator.
No. 228 ...	...	For unions, pipe connecting compressors and loading arm pivot.
No. 229 ...	...	For screws, adjusting correcting gear, level of sights.
No. 235 ...	...	For gland, centre cylinder, accumulator.
No. 236 ...	...	For tightening trench pipe joints.
No. 243 ...	...	For studs, gland, air cylinder (with tommy No. 34).
No. 286 ...	...	For tray loading.

Spanners, hydraulic buffer :—

No. 26 ...	...	For screws supporting trunnion ball-bearings.
No. 49 ...	...	For plug, filling hole.
No. 83 ...	...	For glands, front and rear hoist.
No. 104 ...	...	For gland, large.
No. 105 ...	...	For gland, small.
No. 106 ...	...	For stuffing-box.
No. 107 ...	...	For nut piston rod.
No. 108 ...	...	For gland, valve spindle filling and emptying, also withdrawing packing ring air cylinder.
No. 109 ...	...	For plunger controlling (with tommy No. 32).

Screwdrivers :—

No. 10 ...	...	For small screws of automatic sighting gear.
No. 14 ...	...	For screws fixing accumulator pumps.

Eyes, lifting :—

No. 1 ...	...	For capsquares.
No. 2 ...	...	For front shield and withdrawing piston rod.
No. 3 ...	...	For cap band, connecting gun and buffer and rear gun band.
No. 4 ...	...	For side and pit shields.

Lever :—

No. 4 For lengthening spanners.

Loop, lifting :—

No. 6 For rings, friction, elevating gear.

Wrench, front gun band.

Tommies :—

No. 18 For spanners Nos. 211, 219 and 236.

No. 29 For spanners Nos. 217 and 218.

Sleeve, supporting spring block, accumulator.

Syphon, accumulator pump.

CARRIAGE, GARRISON, B.L. BARBETTE, 9·2-INCH, MARK VI.

(Plate XX.)

In general design it resembles the *Mark V*, but the hydraulic gear, with accumulators, hoists and pipes, also trollies under the shell-pit shield, are not provided.

The carriage consists of the following parts :—

- Body.
- Cradle.
- Hydraulic buffer.
- Elevating gear.
- Traversing gear.
- Loading gear.
- Shields (front, side and shell-pit).
- Sighting platform.
- Elevation indicator gear.

The carriage which takes the *Mark X* gun is constructed to allow the gun to be fired between the angles of 10° depression and 30° elevation inclusive and to give an all-round traverse. The loading angle is 5° of elevation. The carriage body is generally similar to the *Mark V* body from which it differs principally in the sides, which are extended upwards to allow for the increased angle of elevation.

The cradle and hydraulic buffer are similar to those used on the *Mark V* carriage, a new valve key being used in the buffer and the pressure in the air recuperator is increased to 320-lbs.†

The traversing gear is also similar to that used on the *Mark V* carriage.

Elevating gear (Plates XIV and XXIV).—The general arrangement of the elevating gear is similar to that of the *Mark V* carriage and worked from the same positions; in addition, the gun can be elevated or depressed by a motor driven by an engine.

The latter is carried in a frame attached to the right side of the mounting under the shell-pit shield, and pipes connect the engine pump with a motor carried in a framework on the left side of the mounting.

† NOTE.—To charge the intensifier see page 73.

The motor is connected to the elevating gear by means of a clutch actuated by a lever so arranged that when the motor is in gear the lower elevating wheel is thrown out of gear. The motor is operated by a spring control lever pivoted to a bracket on the underside of the shell-pit shield. This lever works along a quadrant engraved with the words "Elevate" and "Depress," and the quadrant has a notch for locking the lever in the neutral position.

Voice tubes are provided from either sighting platform to the position of the "Number" operating the control lever.

Note.—When elevating or depressing by means of the motor it is necessary to keep clear of the upper elevating handwheels.

Elevation indicator.—This is of the *Mark II* type described on page 46, but in lieu of the arc it is actuated by a rack formed on the lower end of a rod, the upper end of which is attached to a bracket riveted to the front transom of the cradle.

Loading gear.—A new type of loading gear is provided, consisting principally of a petrol-driven engine driving a Hele-Shaw pump, which supplies liquid to a hydraulic press. A tackle attached to the ram of the latter has its end led over guide pulleys on a derrick pivoted to the top of the shell-pit shield on the left side, the end of the rope being made fast to a shell grab. Liquid can be admitted to, or exhausted from, the press by means of a control valve actuated by a lever on the top of the shell-pit shield near the loading derrick.

A circular railway is laid in the emplacement floor on which run two trollies, each holding two shell, for conveying the shell to a point immediately under the loading derrick, at which point a projectile guide is suspended from the shell-pit shield. The guide keeps the projectile square in its ascent to ensure it being in correct alignment for passing through the opening in the shell-pit shield. At the bottom of the guide is a catch which holds the trolley in the correct position for the shell to be in line with the guide, even although the mounting be traversed, as the trolley is then pushed round with the mounting.

To load a shell the trolley is run round with the shell till it is brought up by the stop on the guide.

The lever of the control valve is worked, thus overhauling the tackle until the grab can be locked on the shell. It is also worked to raise the shell which moves up its guide through the opening in the shell-pit shield till it is high enough. The gun is brought to 5° elevation, the shell lowered off into the loading tray and the latter swung round into the breech opening where the shell is rammed home.

In case of breakdown of the hydraulic gear the shell can be raised by means of an auxiliary tackle actuated by a winch on the derrick (*Plates XXI and XXII*), the hydraulic gear having first been disconnected.

Shields.—The front shields, which are armour-plated, are higher in order to give the necessary protection to the higher carriage. A loading platform, on which the numbers stand for ramming home, is fixed to the top rear end of the shell-pit shield.

The remaining parts of the carriage are similar to those of the *Mark V*, omitting all reference to the various parts of the hydraulic loading gear of that carriage.

CARRIAGE, GARRISON, BARBETTE, B.L. 9·2-INCH, MARK VIA.

The *Mark VIA* carriage differs from the *Mark VI* only in the carriage body, which is the *Mark V* carriage body converted to allow of increased elevation being given to the gun.

PLUG, PIVOT, No. 19A.

This plug is prepared for use with No. 7 carriage pedestals with barbette, B.L. 9·2-inch *Mark VI* and *VIA* carriages and has a hole at the top for eye, lifting No. 3.

It only differs from the No. 19 plug described on page 56, in being solid and not having the steel feather.

THE HELE-SHAW PUMP.

The pump is of the rotary plunger type, and, therefore, is positive in action. It is reversible and of variable capacity and can be rotated at high speeds.

The pump consists of the following principal parts ;—

Cylinder body.
Central valve or " D " tube.
Floating ring.
Slippers.
Inner and outer case.

The " D " tube acts as a fixed spindle and the cylinder body has seven pistons which are fitted with gudgeon pins so that any tangential pressure is borne directly on the cylinder wall.

Both ends of the gudgeon pins pass through slots in the cylinder wall, and on each end is a slipper fitting in a circular groove in the inside of the revolving floating ring. This ring can be moved to and fro, but is allowed to rotate freely on ball bearings which are carried by the guide blocks, sliding in grooves in the main case and connected to the stroke varying spindle.

When the cylinder body is revolved the floating ring revolves with it, the resistance of the slippers being greater than that of the bearings ; in the central position the slippers make no movement in their grooves, and in any other position only move to and fro to an extent directly proportional to the stroke.

This effects a great saving of power.

The floating ring is retained full of oil by centrifugal force, the main casing surrounding it being kept empty.

Advantages Claimed.

1. Uniform and steady discharge under all pressures.
2. Balance.
3. Durability.

SIGHT, AUTOMATIC, CARRIAGES, GARRISON, MARKS VI AND VIA
B.L. 9.2-INCH, MARK I.

(Plate XXV.)

The sight is arranged on the right side of the carriage and consists of the following principal parts:—

Telescope carrier.
Telescope carrier hinge flap.
Hinge flap supporting bracket.
Cam roller lever.
Cam roller lever pivot.
Spring case.

The *telescope carrier* is pivoted horizontally to the hinge flap and is free to slide laterally in an undercut recess in the rear of the latter, when the deflection gear is operated. The carrier has an arc with worm teeth formed on its rear end, into which gears a worm on a spindle supported in bearings in the hinge flap. A graduated deflection scale ring is fixed to a drum mounted on the outer end of the worm spindle, and is read by a reader secured to the hinge flap.

The deflection scale ring is graduated in multiples of 5' to a maximum of 2° right and left deflection, every 15' being numbered and marked with the letter "R" or "L" denoting right and left deflection respectively.

The *hinged flap* is hinged to the front end of the supporting bracket and connected to its rear end by an adjusting screw, the latter works in the error of the day adjusting nut, which is held in an undercut recess in the supporting bracket, and held friction tight by means of a spiral spring. The adjusting nut, which is drum-shaped, carries the error of the day ring, which is secured by a screw and nut. The scale is read by a reader attached to the supporting bracket. When the drum is turned it causes the screw to work up or down, and so alter the position of the hinge flap in relation to the cam roller lever.

The *cam roller lever* is pivoted about its centre to a supporting bracket on the cradle, and secured at its upper end to the hinge flap supporting bracket. At the lower end of the lever is a roller which works in the cam groove of the automatic sighting gear, and is kept pressed against the working edge of the groove by a spiral spring contained in a case.

The *cam roller lever, pivot* is supported eccentrically in its bearing to permit of adjustment, and is inclined at an angle of 3° to compensate for drift.

The telescope employed is the "Telescope, sighting, No. 7, Mark I."

The ring and reader error of the day drum are identical with those for use with the *Mark V to V_B* carriages.

Note.—For future manufacture the cam roller lever and its axle will be provided with an oil hole for the purposes of lubrication, and a cannellure will be formed on the inner surface of the cam roller to act as a reservoir for the oil.

SIGHT, ROCKING-BAR, CARRIAGES, GARRISON, MARKS VI AND VIA,
B.L. 9·2-INCH, MARK I.

(Plate XXVI.)

The sight consists of the following principal parts :—

Carrier with adjusting bushes and worm-wheel bracket.

Rocking-bar with arc and deflection gear.

Sight-bar with fore and hind sights and telescope holders.

The *carrier* is attached to a supporting bracket on the left side of the carriage by two screws working in concentric and eccentric bushes, respectively, which permit of adjustment and is inclined at an angle of 3° to the left to compensate for drift.

The *rocking-bar* is hinged to the carrier about its centre by a hinge bolt and connected to the rear of it by an arc gearing into the worm-wheel bracket of the carrier. This worm-wheel gear is actuated by a hand-wheel and permits of 30° depression of the sight. The amount of depression applied to the sight is indicated on a degree strip attached to the arc. The rear end of the rocking-bar is shaped to carry the deflection gear, and is bored vertically at its front end to take the pivot of the foresight holder.

The *deflection gear* consists of a nut working on a traversing screw which is actuated by milled heads. The maximum amount of deflection obtainable is 2° right and left.

The *sight-bar* is pivoted to the rocking-bar at its front end through a pivot formed on the foresight holder and connected to the rear end of it by a lug which fits on the deflection nut. It is provided with fore and hind sights, two telescope holders, a sighting blade and sighting blade turning bar with spiral spring. The telescope employed with the sight is "Telescope, Sighting, No. 7, Mark I."

The *drum yard scale* is made of gunmetal 14-inches in diameter, and is fitted with screws and nuts for the attachment of the various yard scale rings. Yard scale rings of nickel alloy are provided for the full, three-quarter charges, 6-pr. sub-calibre and 1-inch A.R.

CARRIAGE, GARRISON, BARBETTE, B.L. 9·2-INCH, MARKS VI AND VIA.

List of Lubricating Holes.

Articles.	No. of Holes.	Remarks.
Hinges of doors, shell-pit shield ...	4	Accessible from top of shield.
Wheels, projectile trollies ...	8	For lubricating axles, four on each trolley.
ABOVE SHELL-PIT SHIELD.		
Bearings, ball, trunnion ...	2	In retaining nuts.

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List of Lubricating Holes—continued.

Articles.	No. of Holes.	Remarks.
ABOVE SHELL-PIT SHIELD—contd.		
Brackets, cross-shaft—		
Elevating, centre	—	These brackets, which are not capped, are situated at the front of the carriage: a small quantity of oil should be applied where the shafts take bearing.
Traversing, centre	—	
Left side—		
Arc, pinion, shaft, left	1	
Cross and vertical shaft		
Elevating, left	2	One for vertical shaft and one for cross-shaft.
Traversing, left	1	For cross-shaft; also a groove in bearing for vertical shaft.
Elevating and traversing gear, left, upper	4	One in each bearing for hand-wheel spindle.
Capsquare, left	1	The tapped hole for lifting eye.
Clips, guide, cradle, left	8	For lubricating sliding surfaces.
Crane, Loading—		
Bracket, right	1	Windlass detail.
Bracket, left	1	Windlass detail.
Derrick	1	For lubricating upper bearing in pillar.
Drum, brake	3	Windlass detail.
Drum, wire rope	5	Windlass detail.
Pillar, derrick	1	For lubricating lower bearing.
Sheaves	2	On top of derrick.
Stud, pinion	1	Drum, wire rope detail.
Pillar, loading arm	1	For lubricating lower bearing.
Post, loading arm	1	For lubricating upper bearing in pillar.
Rack, elevation indicator	1	Front end of rack, for hinge pin.
Right side—		
Bearing, pin, elevation stop	1	
Bracket—		
Arc, pinion shaft right	2	In upper bearing for lubricating anti-friction worm bearings; also a lubricating pipe conveying lubricant to shaft.
Cross and vertical shafts—		
Elevating, right	2	One for worm-shaft and one for cross-shaft.
Traversing, right	1	For cross-shaft; also a groove in bearing for vertical shaft.
Elevating and traversing gear, right	3	One in each bearing for hand-wheel spindle.
Wormwheel spindle, gear correcting auto-sights	2	One in each bearing.
Shaft, rack pinion	1	In upper end of shaft.
Wheel, spur, intermediate shaft, traversing gear	1	In boss of wheel conveying lubricant to shaft bearing.
Capsquare, right	1	The tapped hole for lifting eye.

List of Lubricating Holes—continued.

Articles.	No. of holes.	Remarks.
ABOVE SHELL-PIT SHIELD— <i>contd.</i>		
Clips, guide, cradle-right	8	For lubricating sliding surfaces.
Wheels, bevel, vertical shaft—		
Elevating gear, upper	1	Through boss of wheel, convey- ing lubricant to shaft bear- ing; accessible through cover of guard.
Traversing gear	1	
UNDER CRADLE.		
Bracket, arc pinion shaft, centre... ..	1	Four oil grooves, in centre pivot bearing, for lubricating pivot plug.
Carriage, body	—	
BELOW SHELL-PIT SHIELD.		
Roller, ring, axles	26	In head of axles; accessible from right side and left side, but to lubricate all the axles the mounting must be tra- versed.
<i>Left side—</i>		
Bracket, elevating and traversing gear, left, lower	2	One in each bearing for hori- zontal shaft and both bear- ings for vertical shaft, cupped, to receive oil.
Elevation indicator detail—		
Bearing, spring barrel shaft	1	
Bracket, driving shaft	3	
Bracket, supporting elevation indicator	2	
Guide, rack	3	
<i>Loading gear—</i>		
Brackets, shaft controlling pump	2	One in boss of each bracket. Hoist detail.
Pin, sheave	2	
<i>Right side—</i>		
Pump, air	1	In cylinder, for lubricating plungers and slide for rocking lever.
<i>Pinion, spur, traversing gear—</i>		
Intermediate shaft	1	In boss of { Conveying lubri- pinion cant to shaft bearings; acces- sible through hinged door of gear cover.
Vertical shaft	1	
Wheel, spur, rack pinion shaft	1	

NOTE.—In addition to the foregoing, all working parts, *e.g.*, joints of levers, catches, &c. (where lubricating holes are not provided), should be occasionally oiled.

SPANNERS AND SPECIAL IMPLEMENTS (MARKS VI AND VIA MOUNTINGS).

Clamp, adjusting intensifier piston.

Pipe, filling intensifier (with funnel).

Spanners :—

No. 1 ...	...	...	For gland, intensifier.
No. 51 ...	...	...	For filling and emptying valve connection, &c.
No. 98 ...	...	...	For valve filling and emptying, &c.
No. 203 ...	...	...	For filling and emptying valve, gland, air cylinder.
No. 206 ...	...	...	For tube, gland or piston rod plug.
No. 208 ...	...	...	For plug, outer air cylinder.
No. 209 ...	...	...	For nut, adjusting trunnion ball-bearing ring.
No. 212 ...	...	...	For nuts, arc pinion shaft.
No. 225 ...	...	...	For 3·546-inch nuts, holdfast, carriage pedestal.
No. 226 ...	...	...	For 3·17-inch joint plate bolts and nuts, carriage pedestal.
No. 229 ...	...	...	For screws, adjusting correcting gear, level of sights.
No. 243 ...	...	...	For studs, gland, air cylinder (with tommy No. 34).

Spanners, hydraulic buffer :—

No. 26 ...	...	...	For screws, supporting trunnion ball-bearings.
No. 49 ...	...	...	For plug, filling hole.
No. 104 ...	...	...	For gland, large.
No. 105 ...	...	...	For gland, small.
No. 106 ...	...	...	For stuffing box.
No. 107 ...	...	...	For nut, piston rod.
No. 108 ...	...	...	For gland, valve spindle filling and emptying, also withdrawing packing ring air cylinder.
No. 109	For plunger, controlling (with tommy No. 32).

Screwdriver :—

No. 10	For small screws of automatic sighting gear.
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Eyes, lifting :—

No. 1	For cap-squares.
No. 2	For front shield and withdrawing piston rod.
No. 3	For cap, band connecting gun and buffer and rear gun band.
No. 4	For side and pit shields.

Lever :—

No. 4	For lengthening spanners.
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Loop, lifting :—

No. 6	For rings, friction, elevating gear.
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Wrench, front gun band.

CARE AND PRESERVATION OF CARRIAGES, &c.

A Memorandum of Examination is issued with each mounting, this is intended to preserve a complete history of the mounting and the sight, together with a record of all rounds fired, and should be kept in the sub-district office. The table of angles and the number of the cam will be recorded in the memorandum as soon as the sight is fitted to the mounting and reported to C.I.W. on A.F. G 832.

On completion of erection, removal, alteration or repair, of a mounting, particulars of the work done must be recorded on the

memorandum with the dates when executed, and the same particulars should be entered on A.F. G 832 and sent to C.I.W. through the C.O.O. for record.

The number of rounds (except blank and sub-calibre) fired from each mounting will be entered in the memorandum by the officer in charge at the conclusion of each day's practice, so that an accurate record can be kept.

An annual report of rounds fired with projectile will be sent to the C.I.W. on A.F. G 874 by the C.R.A. In all correspondence and reports relating to mountings their natures, marks and registered numbers should be quoted.

Care must be taken that mountings are kept in working order, as iron and steel parts are liable to deteriorate owing to rust, which would cause irregularity in action.

A thorough cleaning and lubricating of all working parts must take place once a month, all clotted grease being removed and parts wiped with an oily rag. Special care must be taken to prevent grit getting on the sliding surfaces.

Rollers should be numbered so as to enable a proportion to be removed and cleaned monthly and the guns should be fully pumped back monthly.

In lubricating, the lubricating holes will be cleaned out with a wire and filled with oil, care being taken to replace the screws, the heads of which should be kept bright so as to be readily seen.

In all cases where guns are mounted the buffer will be kept filled with the proper quantity of oil and the piston rod connected up.

The cylinders of buffers should be emptied every 12 months, care being taken that the fluid is well stirred up by moving the piston backwards and forwards. The fluid drawn off will be filtered and if not then too thick may be used again.

The pressure in the air cylinder should be taken at least once a week to see if loss occurs. A liquid gland prevents the pressure from escaping, which is fed by an intensifier; care should be taken that it is kept fully charged. This can be ascertained by measuring the length (about 10-inches) from end of intensifier piston to end of intensifier gland.

The air cylinder should always be filled previous to charging the buffer.

Once a week the mounting should be traversed through its arc of fire, elevated and depressed, the accumulator pumped up to its highest point and the hoists worked. The accumulator when not in use should be pumped up half way from the bottom stop. The strainers of the accumulator will be cleaned every three months and in the event of the rear hoist failing to rise the whole system will be emptied and washed out.

Ball bearings must be lubricated with red mineral jelly.

Leathers for glands, pistons, &c., when kept in store, should be free from dust and periodically smeared with dubbing to keep them soft and flexible.

All sights are to be handled with care, all parts to be kept clean and well lubricated with clean oil and (with the exception of the roller path and cam roller of automatic sights) slightly smeared with grease when not in use.

All adjustments must be carried out by a competent artificer.

Whenever any parts are found broken, defective, or deficient, which cannot be renewed by the artificer, fresh parts should be demanded at once. Any damage occurring at drill or practice should be at once reported, with a view to being made good without delay.

Painting.—Guns, mountings and stores will be cleaned and painted biennially with two coats of paint, but they may be cleaned and painted as often as is considered necessary to prevent deterioration from exposure, on the authority of the G.O.C.

Paint will be of such colour as to render the guns as inconspicuous as possible and one mounting will be marked with the date of painting.

Before repainting, guns and mountings will be stripped of all loose parts, examined and thoroughly overhauled by the artificer under the I.O.M. when all blisters, dirt and grit will be removed.

After the operation of scraping, the gun or mounting should be wiped over with old canvas before applying the first coat, which should be allowed to set thoroughly before applying the second.

On completion of painting, lettering will be done in accordance with Regulations.

MARK IV MOUNTING.

Before the erection of the mounting is commenced, special attention must be directed to the following points :—

- (a) The racer must be perfectly level.
- (b) The roller path, upper and lower teeth of traversing rack, rollers and the underside of flange of pivot plate where the clips engage, must be quite clean and free from burrs.
- (c) It should be seen that the roller ring has not been bent.

The rollers and axles must be oiled, placed in the roller ring and the ring given two or three revolutions on the roller path before putting on the mounting, to make sure that it runs truly.

The upper roller path should be cleaned and oiled and any burrs removed; the mounting should then be lifted into position. The traversing gear and pointer should then be attached and one or two revolutions made to see that the mounting traverses truly. The level of the racer may be tested by a spirit-level placed on the mounting. Put on the clips and make another revolution to ascertain that they do not bind on the clip ring of the racer.

Particular care must be taken that the connecting band, elevating arcs and pinions are put together correctly, or otherwise damage may occur. The friction clutch in the wormwheel should be tightened just sufficiently to prevent the elevating arcs running down when the gun is mounted. The clutch consists of alternate plates of steel and metal and their surfaces should be slightly oiled. The gear should be elevated and depressed frequently to prevent the trunnions adhering to the bearings.

Before connecting the piston rod, it should be pushed in and out to see that it works freely and that the packing of the gland is not too tight.

To prepare for firing. (See Plate XI.)—Charge the intensifier and liquid gland by pumping in oil at (A), which is at the left side of the intensifier; let air escape at (M), which is on top of liquid gland near the front. For re-filling, the piston rod of the intensifier may be forced in by a screw clamp (for description see page 35) and the oil poured in at plug (A) by means of a long pipe with funnel, but the pump must always be used when initially charging.

Charge the chamber through valve (D), which is at the rear of the air chamber, to a pressure of 200-lbs. per square inch. About three quarts of oil should first be pumped into the air chamber.

With the gun at elevation, fill the buffer with oil by pumping in at (E), which is at the underside of buffer cylinder, near the front; let air escape at (L), which is on top of buffer cylinder and also at front end of piston rod, by slackening off the gland. When buffer is full, draw off $\frac{1}{4}$ of a pint.

Contents, $9\frac{1}{2}$ -gallons of mineral oil.

Hydraulic buffer.—Before removing the buffer glands for renewal of the leathers and packing, the gun must be run back to the most convenient position, secured in that position and the buffer cylinder emptied. The lengths of packing should be well greased before use, taking care that when putting them in, the joint of the packing rings do not come opposite each other. Great care should also be taken in putting the L-leather in the buffer gland, to see that the edges enter properly without being damaged.

In cases where it is found that the guns do not run up to the front stops, a flat surface will be filed on the controlling plunger, or screw plug of controlling plunger, to allow of the gun running up to the stops without violence.

When the cradle is mounted in its bearings on the carriage, secure the elevating arcs to the sides of the cradle, screw on the capsquares and fix the ball-bearings in position.

MARK V MOUNTING.

Before the erection of the mounting is commenced, special attention must be directed to the following points :—

- (i) In cases where not more than $132^{\circ} 30'$ traverse on either side of the centre line passing through the front and rear of the emplacement is required, telescopic exhaust pipes are used. It must be noted that the centre line of the key-way for the pivot plug should be $2\frac{1}{4}$ -inches to the left rear of the centre line of the emplacement. Where more than this traverse is required, the telescopic exhaust pipe should be replaced by a rotating joint for exhaust pipe to

admit of all-round traverse and the traverse should be limited by means of the traversing stops, except when both a "rotating joint" and an "apparatus, traversing P.F. dials" are fitted.

- (ii) The stops for limiting the angle of traverse, which are to be fitted locally, must be so arranged that when the springs on the traversing stops are compressed the telescopic exhaust pipe is clear of the centre pivot pipe bend.
- (iii) The instructions as to levelling the racer, correctness of upper path and live roller ring before mentioned will also apply to this mounting.

Care must be taken before firing that the plates of the friction clutch of the elevating gear are quite free from grit, oil, or liquid; in putting the clutch together and to tighten it up sufficiently, the power of four men will be required on the special spanner.

Mineral oil is used in the buffer, which will be invariably kept filled and before filling, care should be taken that the gun is within 2-inches from the front stops. Before replacing the air-hole plug it should be seen that as little air as possible remains in the buffer. This may be minimised by elevating the gun a few degrees from the horizontal while filling the buffer.

No permanent alteration should be made in the pressure laid down for the air chamber and it should be noted that the pressure gauge is giving correct record.

Before firing it should be ascertained by opening stop valve "D" on the accumulator and slackening the air screws in the compressors that the latter are full of liquid to ensure the accumulator being properly charged during recoil. It is also important that the lever of the controlling valve for the front and rear hoists is in the central position and all valves are properly tight upon their seatings except stop valve "E," which should be unscrewed, and stop valve "A," where the handwheel should be revolved to the open position.

Packings.—By pumping liquid into the buffer cylinders the gun may be run back to a convenient position for removal of the small gland and the renewal of the greased packing; but for renewal of the L-leather the buffer must be emptied and the stuffing-box removed, the gun being properly secured in a suitable run-back position. The packing is the "Service greased packing"; it is supplied in lengths. For use it is cut into full lengths, which are prepared and adjusted in the usual way.

To facilitate repacking the ram cylinder glands of accumulators two sleeves will be used to support the spring block.

The ball-bearings of the cradle trunnions should be properly adjusted and kept well lubricated.

To prepare for firing. (See Plate XIII.)—Charge the intensifier and liquid gland by pumping in oil at the valve marked (N), which is

on the right side of the cylinder near the rear; let air escape at (M), which is on top of air cylinder near the front. The piston rod of the intensifier may be forced in by the screw clamp (for description see page 35), so that oil may be sucked in at (N) from a special funnel; this method can only be used to make good leakage.

Charge the air cylinder through the valve (D), which is at the rear of air cylinder, to a pressure of 200-lbs. per square inch; about three quarts of oil should first be pumped into the air cylinder.

With the gun at elevation fill the hydraulic buffer with oil by pumping in at valve (O), which is at the underside of buffer cylinder near the front, letting air escape at (L), which is on top of cylinder over (O) and from the control chamber of piston by slightly slackening back the plug (T) in end of rod. After filling, one quarter of a pint of oil is withdrawn.

Liquid for hydraulic buffer.— $9\frac{1}{2}$ -gallons of mineral oil, normal quantity per carriage.

Accumulator system.—The quantity of "fluid, lifts and jacks, hydraulic," required per carriage, depends upon the distance the accumulator is from the carriage which is not the same in all emplacements.

On completion of the first firing after erection the whole of the liquid must be pumped off from the accumulator system and filtered before being replaced.

Possible misuse of the bye-pass valve of the pump of the hydraulic gear may result in damage.

On no account should leverage other than that afforded by the hand-wheel of the valve be applied. Should difficulty be experienced in effectively closing the valve when necessary, or leakage be observed through the valve when closed, the matter should be reported at once, for adjustment of the valve or seating if required.

MARKS VI AND VIA MOUNTINGS.

To prepare for firing (Plate XXIII).—Charge the intensifier and main gland by pumping oil at "A," let air escape at "C." The piston rod of the intensifier may also be forced in by a screw clamp and the oil then poured in at plug "A."

Charge the air cylinder through valve "D" to a pressure of 320-lbs. per square inch, about three quarts of oil should also be in the air cylinder.

With the gun at elevation fill the buffer with oil at "E," letting air escape at "B," draw off one quarter of a pint.

Contents $9\frac{1}{2}$ -gallons.

The full working recoil is 42-inches.

PARTICULARS OF MOUNTINGS FOR LIFTING PURPOSES.

Mark of Mounting and name of main portion.	Average weight.	Vocab. No. of lifting eye where provided for.	No. of lifting eyes used.	Centre of gravity.
<i>Mark IV Mounting.</i>	Tons cwt.			
Carriage body, with fittings complete	14 16	—	—	Approximately at trunnion centres, but the loops, 2 on each side, are for slinging.
Band connecting gun and buffer	1 9	3	1	
Cradle, including air cylinder and hydraulic buffer ...	8 3	—	—	3½-inches in front of centre of trunnions.
Roller ring—				
Without axles and rollers†...	0 10½	—	—	
With axles and rollers ...	1 4	—	—	
Pedestal, carriage (in halves with joint plates and bolts)				
No. 4 (each half)	9 2½	—	—	
Holdfast, carriage pedestal, No. 4B	3 15½	—	—	
Racer, with traversing rack ...	3 1½	—	—	
<i>Mark V Mounting.</i>				
Bands—				
Connecting gun and buffer, in two parts, with cap and screws	1 8½	3	1	
Gun, rear	0 15½	3	1	
Bars, sliding, gun (2) ... each	0 12½	1	2	
Carriage body, including cap-squares, brackets, cross-shaft, shaft arc pinion and two pinions friction ring, wormwheel and guard ...	13 8	—	—	34-inches in rear of centre line of trunnion.
Cradle, including air cylinder, hydraulic buffer and 4 caps securing compressors ...	9 8	—	—	31-inches in rear of centre line of trunnion.

† As issued. The axle and rollers are packed separately.

CARRIAGE, GARRISON, BARBETTE B.L. 9·2-INCH, MARKS VA, VB VI AND VIA.

Particulars of Mounting for Lifting Purposes.

Particulars.	MARK VA.				MARK VB.				MARK VI.					
	Weight. Tons. cwt.	Vocab. No. of lifting eye, where provided for.	No. used.	Centre of Gravity.	Weight. Tons. cwt.	Vocab. No. of lifting eye, where provided for.	No. used.	Centre of Gravity.	Weight. Tons. cwt.	Vocab. No. of lifting eye, where provided for.	No. used.	Centre of Gravity.	Weight. Tons. cwt.	Vocab. No. of lifting eye, where provided for.
buffer ...	1 4½	3	1		1 4½	3	1		1 8½	3	1		1 8½	3
... ..	—	—	—		—	—	—		15½	3	1		15½	3
... ..	12½	—	—		12½	—	—		—	—	—		—	—
... each	—	—	—		—	—	—		12½	1	2		12½	1
... each	7	3	1		7	3	1		—	—	—		—	—
rackets, cap-	13 8	—	—	34" in rear of C.L. of	13 8	—	—	34" in rear of C.L. of	17 14	—	—	34" in rear of C.L. of	18 0	—
ler, hydraulic	9 8	—	—	trunnions.	9 8	—	—	trunnions.				trunnions.	9 7½	—
compressors...				31" in rear of C.L. of				31" in rear of C.L. of	9 7½	—	—	31" in rear of C.L. of		—
				trunnions.				trunnions.				trunnions.		
tt plates) ...	7 15	2	2		7 15	2	2		10 3	12	2		10 3	12
.	7 6½	2	2		7 6½	2	2		10 2	12	2		10 2	12
. ... each	1 14½	4	2		1 14½	4	2		3 0	4	2		3 0	4
.	7 18	4	3		7 18	4	3		7 18	4	3		7 18	4
.	7 18	4	3		7 18	4	3		7 18	4	3		7 18	4
.	2 2½	4	1		2 2½	4	1		2 2½	4	1		2 2½	4
.	1 14½	—	—	50" from rear and	1 14½	—	—	50" from rear and	1 10	—	—	50" from rear and	1 10	—
ft and 1 right)	1 6	—	—	measured along C.L.	1 6	—	—	measured along C.L.	1 6	—	—	measured along C.L.	1 6	—
lers	11½	—	—		11½	—	—		11½	—	—		11½	—
,	1 14½	—	—		1 14½	—	—		1 14½	—	—		1 14½	—
and training														
al	8 16	—	—	Lightening holes to	8 16	—	—	Lightening holes to	8 16	—	—	Lightening holes to	8 16	—
ate	6	—	—	be used for slinging.	6	—	—	be used for slinging.	—	—	—	be used for slinging.	—	—
plate	—	—	—		—	—	—		8½	—	—		8½	—
ves with joint														
.. each half	8 8	—	—	36" from joint line.	8 8	—	—	36" from joint line.	8 10	—	—	36" from joint line.	8 10	—
l No. 4A ...	4 12	—	—		4 12	—	—		4 12	—	—		4 12	—
ent fittings—														
... ..	3 15½	—	—		3 15½	—	—		—	—	—		—	—
ulator chamber	1 14	—	—		1 14	—	—		—	—	—		—	—
te	10½	—	—		10½	—	—		—	—	—		—	—

PARTICULARS OF MOUNTINGS FOR LIFTING PURPOSES—continued.

Mark of Mounting and name of main portion.	Average weight.	Vocab. No. of lifting eye where provided for.	No. of lifting eyes used.	Centre of gravity.
<i>Mark V Mounting</i> —continued.	Tons cwts.			
Shield, front (with stays)—				
Left portion (with butt plates)	7 15	2	2	
Right portion	7 6½	2	2	
Shields, side (2) ... each	1 14½	4	2	
Shield, shell-pit—				
Left portion	7 18	4	3	
Right portion	7 18	4	3	
Front portion	2 2½	4	1	
Rear portion... ..	1 14½	—	—	50 - inches from rear and measured along centre line.
Plates, top, front (1 left and 1 right, bolted together) ...	1 6	—	—	
Roller ring—				
Without axles and rollers§... ..	0 11½	—	—	
With axles and rollers	1 14½	—	—	
Plates, pivot (with racer and training rack, bolts and screws)—				
No. 4 carriage pedestal† ...	8 12	—	—	The lightening holes to be used for slinging.
No. 7 carriage pedestal ...	8 16	—	—	
Plug, pivot, No. 19 (with plate)... ..	0 6	—	—	
Pedestal, carriage (in halves with joint plates and bolts)—				
No. 4† ... each half	9 2½	—	—	
No. 7 Mark II ... each half	8 8	—	—	
Holdfast, carriage pedestal, No. 4A	4 12	—	—	
Gear, hydraulic (emplacement fittings)—				
Accumulator... ..	3 15½	—	—	38 - inches from tank end.
Plate, covering accumulator chamber	1 14	—	—	
Hoist, front (with plate) ...	0 10½	—	—	

§ As issued. The axle and rollers are packed separately.

† For five 9·2-inch Mark V Mountings at Dover.

MISCELLANEOUS STORES.

APPARATUS, TRAVERSING P.F. DIALS.

This apparatus is employed if, for any reason, two P.F. instruments are installed for use with one mounting. In connection with each instrument is a pair of trollies carrying range and training dials. The trollies, which are connected by a bar, run on rollers on a circular rail secured to the pedestal, so that they can be readily moved to any convenient position within the arc of traverse served by their particular instrument. The trollies are prevented from moving beyond the limits of this arc by stops. The cables from the P.F. instruments are led to a terminal board inside the pedestal of the mounting, and thence through the side of the pedestal over guide rollers to the dial trollies. Sufficient slack taken up by the counterweights is left in the cables to permit of the movement of the dial trollies.

BAR, TESTING SIGHT, AUTOMATIC AND ROCKING-BAR.

The bar is used for testing by means of the Service clinometer, the accuracy of the automatic and rocking-bar sights. It is formed to fit the telescope holders and with a plane for the clinometer. An arrow-head is engraved on the rear end, which will be set to correspond with a similar arrow-head on the rear telescope holder to ensure correct cross-level of the plane.

When testing the angle between the gun and the sight the clinometer readings will be taken from the bar fixed in the holders.

BIT, VENT, 36-INCH.

This is of round tempered steel wire, furnished with a spiral bit at one end and hardened at the point; the opposite end is formed into a loop for convenience in handling. It is used for removing irregularities from the vent channel and for cleaning it.

BOLTS, EYE (CARRIER HINGE BOLT) (HINGE BOLT, CARRIER RING) (WORM, CARRIER RING).

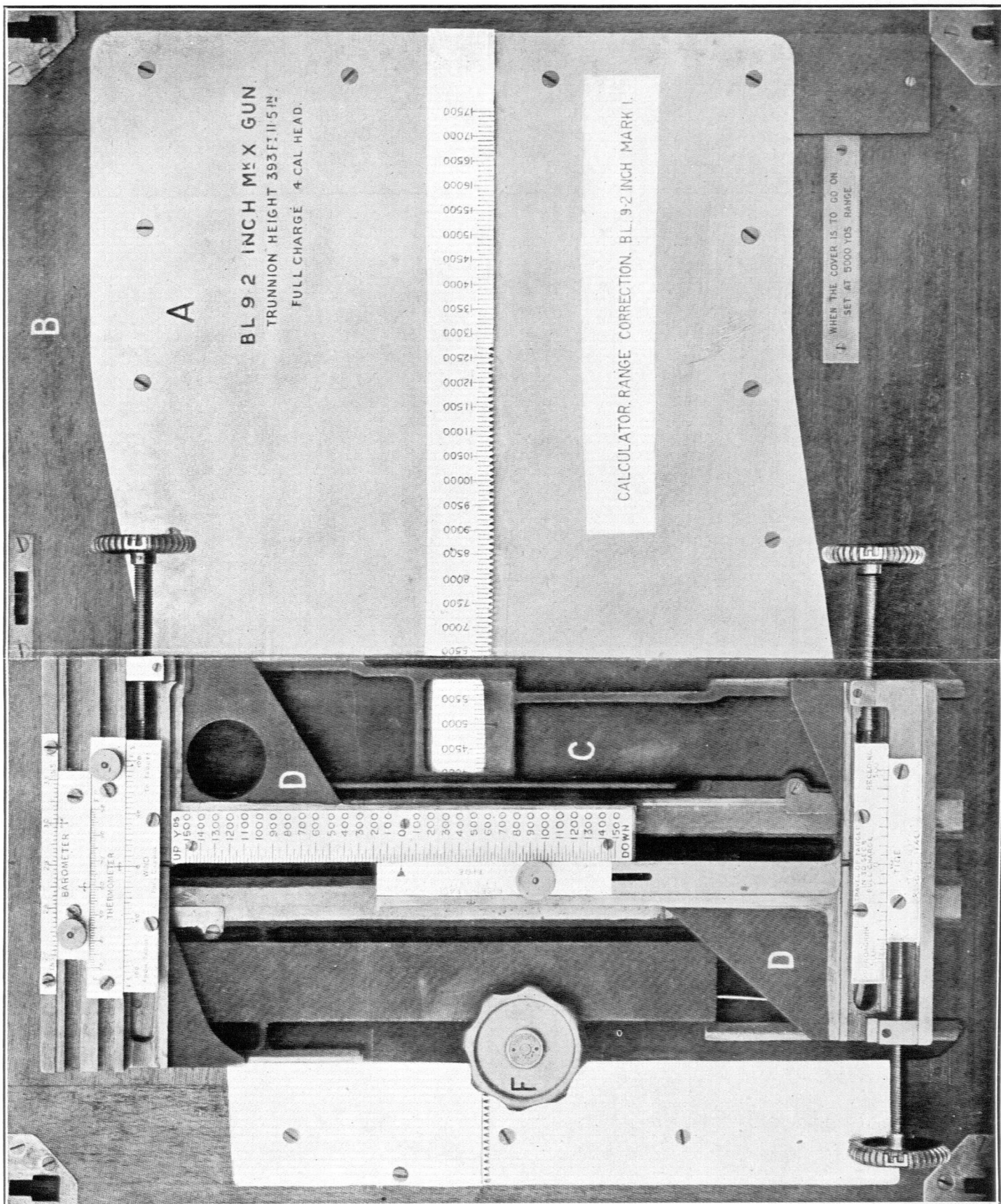
The eye-bolts consist of steel loops with shank having a screw thread corresponding with that in the carrier ring hinge bolt of *Mark IX* and "*C*" *Mark IX* guns, or carrier hinge bolt of *Marks X*, *X^v* and *X** guns, and in the worm of *Mark IX* gun respectively.

BORERS, TUBE CHAMBER, SMALL (SQUARE END) (POINTED END).

The borers are of steel, coned at one end to fit the tube chamber in the axial vent, and are provided with cutting edges for removing obstructions of a hard nature from the tube chamber. The other ends of the borers are provided with a cross-handle.

BOX, OBTURATING PADS AND DISCS, B.L. 9.2-INCH MARKS VIII AND IX AND "*C*" MARK IX GUNS, MARK III.

The box is of wood, the sides being made of deal, ends and bottom of elm, top, battens and internal fittings of mahogany. The sides are dovetailed to the ends and the bottom is secured by brass screws; it holds three pads and three sets of discs.



The box is fitted with a false lid ; a gunmetal bolt passes up through the bottom and both lids. Each lid is secured with a fly nut, both nuts being on the before-mentioned bolt. The false lid thus secures the pad and discs in the box (*see also* "Regulations for Magazines, &c.") by having the fly nut screwed down upon it.

Round the top of the box, under the lid, sheet felt is secured with shellac and tacks to make a tight joint.

On the top of the lid there are two metal plates, each having a folding-down handle for lifting purposes secured by screws ; there is also a recess to contain a label of instructions.

The interior of the box is coated with paraffin wax, and the exterior is painted lead colour.

BOX, OBTURATOR, STEEP-CONED, B.L. 9·2-INCH MARKS X, XV AND X* GUNS.

The box (*Mark I*) is of gunmetal ; the top has a flanged shoulder to take the cover. A steel bolt passes up through the box and a gunmetal nut on the bolt screws down on to the cover, thus compressing the contents. The box holds an obturator and one adjusting disc.

BOX, SPARE PARTS.

The box is made of deal divided into 17 compartments, and is intended to hold the spare springs and other small parts belonging to the gun.

BRUSH, PIASABA, B.L. BORE, 9·2-INCH.

The brush is used for cleaning the bore of the gun in conjunction with a sponge cloth or piece of canvas tied on the head.

The head is of elm, having piasaba tufts secured into it by pitch or marine glue.

The stave is of ash and is secured in the head by a copper rivet. It is fitted with a metal socket-joint which consists of a metal plug fixed to the intermediate stave and a metal cylinder fixed to the brush stave. The plug is inserted in the cylinder and secured in position by a thumbscrew fitted to the cylinder.

Total length with end stave, 28-feet 2½-inches.

CALCULATOR, RANGE CORRECTION, B.L. 9·2-INCH, MARK I. (*Plate XXVII.*)

The calculator is issued for use with the 9·2-inch guns.

By its means the battery commander is enabled to calculate the correction required to the range for any variation from the normal in the external ballistic conditions.

The calculator consists of a metal plate (A) mounted on a wood base (B). Sliding on the metal plate is the main carriage (C), which is actuated by a rack and pinion. The rack, which is fixed to the metal plate, is engraved with a scale of ranges.

Sliding on the main carriage, at right angles to the range scale, are two scale arms (D D) ; one scale arm is engraved with a scale of corrections, the index for which is engraved on the other. The former at its outer end is fitted with scales for barometer, thermometer and

wind, the latter carrying the travel of target and tide corrections. These scale arms are moved with respect to each other in the following manner :—

The wind, travel of target and tide scales are attached to sliding blocks which are moved across the arm by means of the handles (E E E). On the underside of the travel of target and wind blocks are studs, which move along grooved rocking-bars ; the two scale arms are connected together by a spiral spring which is attached to the rocking-bars.

Each rocking-bar is pivoted at its centre and attached to the underside is a lever which has a roller attached to its free end ; this roller follows the shaped edges of the metal plate, causing the rocking-bars to rotate.

When the barometer and thermometer scales are set at normal and the wind, travel of target and tide scales are set at zero, any movement of the main carriage, which is caused by the rotation of the handle (F) will not alter the reading of the correction scale either up or down owing to the studs attached to the sliding blocks being over the centre of the rocking bar pivot.

When the scales are set at any reading other than normal or zero any rotation of the handle (F) will give corrections up or down ; this is caused by the studs attached to the sliding blocks being displaced in the rocking-bars.

Instructions for Use.

Set the barometer, thermometer and the two tide scales to the prevailing conditions.

Set the wind and travel of target scales to indicate the respective velocity components in the plane of sight.

Set the main carriage to the range and read the correction ; if on the "UP" scale the correction to the range is "PLUS" ; if on the "DOWN" scale it is "MINUS."

CONNECTIONS, PRESSURE GAUGES.

The pressure gauge is attached to the vessel to be charged by a three-way connection, one opening of which screws on to the nozzle of the filling cock, the opposite one takes the pump tube, and the centre one the gauge. When the gauge is not on this opening, it is closed by the closing plugs. There is a cut-off valve with supporting nut, which closes the way to the gauge while leaving the passage free between the pump and the cylinder. The way to the gauge should not be left open while pumping or firing is going on as the gauge is likely to suffer.

COVER, BREECH, B.L. 9·2-IN. MARK IX GUN.

This cover is made of canvas having the inside (at the rear) lined with leather, the outside being waterproofed. It is arranged to cover the whole of the breech and breech fittings and is secured round the gun by a strap sewn into the front edge of the cover.

COVER, CARRIAGE.

The cover is of waterproof canvas, formed to protect the working parts of the carriage. It is secured in position by straps and buckling-pieces, which are stitched on.

COVER, MUZZLE, No. 7.

The cover is of waterproof canvas and is secured to the muzzle by a leather strap.

COVERS, PROTECTING ROLLER RING.

The covers, which are right and left, are for protecting the exposed portions of the roller path and ring from dirt and grit. They are made and fitted locally to carriages received without them.

DRIFTS, EJECTING TUBE, NOS. 2, 4 AND 6.

The drifts are made of round steel, slightly smaller in diameter than the fire channel in the axial vents. The front end of the drifts are coned to prevent burring and the rear ends are furnished with steel heads.

The drifts are for use in removing tight vent-sealing tubes from the tube chamber in the vents.

EXTRACTOR, CARTRIDGE, B.L. 9.2-INCH TO 7.5-INCH.

The cartridge extractor is a copper hook which is secured in a wood stave. The total length is 6-feet.

EXTRACTOR, DRILL SHELL, No. 2.

The extractor consists of an ash stave grooved circumferentially at one end to enable a good grip to be taken when extracting the drill shell. The other end of the stave is furnished with a steel hook for engaging the crossbar of the shell. Total length, 8-feet.

EXTRACTOR, TUBE, HAND, BOX SLIDE, "A" No. 2.

The hand tube extractor is for use with guns having *Marks I** or II* "boxes slide A" with strengthened extractor, when the tube is so tightly jammed in the vent that the extractor in the box slide fails to remove it.

The extractor consists of a steel lever shaped so as to admit of the insertion of one end under the extractor lever in the box slide. On exerting pressure on the outer end of the hand extractor, the tube will be forced out.

FUNNEL, FILLING CYLINDERS, No. 9, MARK I.

This funnel consists of a tin plate cone-shaped body, having at the top a wired beaded edge and a wire (D) loop secured by a tin strip riveted and soldered on the outside and at the bottom, with a tin plate spout. This funnel is for use with "Carriages, Garrison, B.L. 9.2-inch Marks VI and VIA."

GAUGES, PRESSURE.

(Plate XXVIII.)

The gauges generally consist of a metal cylinder containing the mechanism, which is closed in by a 6-inch dial and a sheet steel plate at the back.

The mechanism consists of a metal bearing which is attached to the cylinder and dial plate; that part of the bearing which is attached to the dial plate is flattened and suitable bearings are secured to it for the spindle of the dial indicator and for a crank through which the indicator is actuated, while that part of the bearing which is attached to the side of the cylinder has a channel which is in continuation of the connection (for "Connection, pressure, gauge," or "Connection, four-way, air-pump"); in one side of this channel is a hole in which one end of a short phosphor bronze tube (No. 4 gauge has steel tubing, owing to the high pressure it is subjected to) is inserted and soldered. The tube is slightly flexible and is bent partly round the cylinder, its opposite end being closed with a cap, to which is attached a crank arrangement working on a pivot and which has an adjustable arm attached to a segmental rack in gear with a pinion on the spindle of the dial indicator.

Each instrument is provided with a dial indicator stop, fixed either on the dial or within, against some part of the mechanism. Each one is constructed to register the hydraulic pressure per square inch.

Action.—On pressure entering the bent tube within the gauge, it gradually inclines the tube outwards; thus the dial indicator is actuated through the pivoted crank and segmental rack. When the pressure is removed from the instrument, the dial indicator returns to stop at the normal position.

The following spanners are used with the gauges, &c. :—

Spanners—

No. 103 ... For gauges, pressure, Nos. 1 to 4; also pressure gauge connections.

No. 104 ... For connections, pressure gauges.

A box for the pressure gauge will be provided locally. It is made of deal and fitted with a hook and staple.

GAUGE, STRIKER, ECCENTRICITY, SMALL.

This gauge is of brass, with a removable copper plug, for testing eccentricity of striker in guns using "P" vent sealing tubes.

GAUGE, STRIKER, PROTRUSION, No. 3.

The gauge is made of flat steel plate and is for gauging the protrusion of the firing pin of the needle or striker in electric or percussion locks, for B.L. guns and the striker in 1-inch Elswick "B" aiming rifle. It has separate recesses for maximum and minimum gauging and the depths of the recesses are as follows :—

Maximum ...	...	...	...	...	...	•09-inch.
Minimum ...	...	...	...	...	...	•07-inch.

HEAD, BRUSH, RAMMER AND SPONGE, B.L. 9·2-INCH CHAMBER.

The head which forms the rammer and sponge is made of elm, which is protected in front by a brass ring secured by brass screws. The part in front of the brush is covered with fleecy hosiery, which is secured by copper tacks and the brass ring. The brush portion is made of beech or birch in two parts, one part forming the brush and the other

a packing ring. The tufts of bristles are secured in position by brass wire, which is housed and secured in suitable grooves; the brush is retained in position on the head against a shoulder by an undercut and by an angle copper ring and screws.

HOLDERS, SIGHT CAM, SIGHT BAR AND BAR TESTING SIGHT.

The holders are of wood and are formed to protect the cams, sight bars and bar testing sight when they are not in use on the carriages.

IMPLEMENTS, AMMUNITION—KEY, No. 8 (MARK IV).

Is a steel key with suitable projections formed on it to fit the slots in the Nos. 11, 15 or 16 base fuzes, for inserting or removing purposes, or their corresponding plugs.

IMPLEMENTS, AMMUNITION—KEY No. 23.

This key is made of steel, T-shaped, for use with G.S. and 2-inch plugs. It is also suitable for fixing or removal of D.A. percussion fuzes, of this equipment.

IMPLEMENTS, AMMUNITION—KEY, INSERTING AND REMOVING, PRIMER, CARTRIDGE, AIMING RIFLE, 1-INCH, ELECTRIC, MARK I.

The key is of steel and is for use in inserting and removing the primer of electric cartridges.

LANYARD, COCKING, No. 2.

This lanyard is made of tarred white line with toggle at one end and at the other end with loops for looping over the lugs of the cocking handle of the lock. Length, 4-feet 6-inches.

A clip for supporting the cocking lanyard, consisting of a steel bracket with spring, is attached by a fixing screw to the upper end of the carrier hinge bolt, the existing lubricating screw in the hinge bolt being removed for this purpose.

LANYARD, FIRING, No. 7.

This lanyard is made of tarred white line with toggle at one end and at the other end with hook for hooking on to the trigger of the lock. Length, 8-feet 8-inches.

LEVER, EXTRACTOR, ORDNANCE B.L.

The lever is intended for use in the extraction of V.S. tubes in case they become jammed in the *Mark IX* and "*C*" *IX* guns.

It consists of a steel rod 9-inches long, having toe-pieces at each end which may be inserted in the loop of the extractor to which the lanyard is attached, the sides of the lock frame forming a fulcrum.

PRESS, OBTURATOR, STEEP-CONED, B.L. 9·2-INCH.

GAUGE, THICKNESS, OBTURATOR, STEEP-CONED, B.L. 9·2-INCH.

TOMMY, PRESSES, OBTURATOR, STEEP-CONED, B.L. 13·5-INCH TO 6-INCH GUNS.

The press and gauge are intended for use in re-forming steep-coned obturators which have become so distorted as to cause difficulty in placing them in position on the vent axial in the gun.

The press consists of a steel body shaped internally to suit the contour of the obturator and fitted with a steel cover. The cover is secured by means of a steel bolt with disc spring, disc spring guard washer and cross handle. The bolt is provided with a square head, by means of which the press can be held in a vice while the cross handle is revolved when compressing or releasing the obturator. A steel tommy is provided for use with the cross handle in compressing the obturator. Recesses are formed round the periphery of the press so as to admit of the application of the gauge for testing the thickness of the obturator while under compression.* If the obturator does not readily compress to the correct thickness it should be left under compression for about an hour, then removed and all exuded oil quickly wiped off the pad, discs and interior of the press. The compression and further wiping off of the oil should then be repeated as often as necessary till the obturator is not only of the correct thickness, but also the correct weight (except obturators with wire-woven pads for which limits of weight are not yet specified).

The gauge is of flat steel plate and is for use in testing the thickness of the obturators as described above.

PUMP, AIR, DOUBLE, MARK I.

(Plate XXIX.)

The pump is intended to charge the cylinders of mountings with fluid or compressed air.

It consists of two gunmetal cylinders of different diameters in one casting, with a base plate, on the top of which an iron frame is bolted to form a tank for the fluid while being pumped into the cylinders. The pump cylinders are fitted with plungers actuated by a rocking lever, which is supported on brackets riveted to the tank.

The pump is in duplicate, and is bolted to an iron bedding plate, which is secured to the floor by clips and cotters. It is worked by two T handles which are attached to the rocking levers and are connected at the top by a link to ensure uniform action.

When charging the cylinders with fluid the fluid is drawn through suction valves from the tank into the large pump cylinders, and on the down stroke of the plunger is forced into the small cylinder and delivery pipe through delivery valves. When charging with air the connection between the tank and the cylinders is cut off by closing the valves near the copper delivery pipes, and the air is drawn through a suction valve at the bottom of the large cylinder. This valve is never cut off, but is more heavily weighted than the water valve, and when the water passage is open liquid is drawn in in preference to air, provided the strokes are not too jerky.

Either pump can be disconnected if necessary and worked independently; the delivery of either is cut off by closing the delivery valve. When this is closed the handle must be disconnected so that the pump which is cut off may not be worked.

The pump tank should always be kept full.

To keep the leathers in good order they should be slightly under pressure. To obtain this screw one length of pipe on to the delivery

nozzle, blanking the free end of the pipe with a cap. Set the pump for "Air" and pump air into the pipe till the handles become difficult to work.

When standing long in store the pump should be worked occasionally to see that the pressure is still on.

A cover is fitted to the iron bedding plate to protect the small pipes which connect the base of the pump to the three-way connection.

When it is found that the cylinders of the pumps are defective from excessive wear and scoring they will be bored to a larger diameter according to the amount of wear and fitted with new plungers and L-leathers. The thickness of the cylinders will not allow, at the most, of more than 0.15-inch enlargement, and this amount must not be exceeded. On the enlargement of a cylinder the word "Large" will be stamped on the new plunger.

Belonging to the pump are four connecting pipes, five spanners (Nos. 96 to 100), and one lifting loop.

Weight, 4-cwt. 1-qr.

Maximum working pressure, 2,800-lbs. per square inch.

PUMP, AIR OR LIQUID.

(Plate XXX.)

Mark I.—The pump is double-acting, and is intended for charging the cylinders of mountings with fluid or compressed air and reservoirs with compressed air. (Whenever it is possible the reservoirs should be recharged by engine power. This can usually be carried out by local workshop.) It is contained in a metal tank bolted to an iron stand, which is secured to a wood platform. A canvas cover is provided to prevent grit and dirt getting into the working parts when not in use.

The pump consists principally of the following parts:—

1. High and low-pressure plungers. The former is fixed to a crossbar at the top of the tank, having a gunmetal washer inserted between the seating and the L-leather and the latter to the bottom of the tank.
2. Suction, intermediate and delivery valves.
3. Metal cylinders, formed at one end to receive the high-pressure plungers and at the other the low-pressure plungers.
4. Outer plungers.
5. Overflow valves.
6. Cock for admitting air or liquid to the pump.
7. Double handle lever for actuating the cylinders.

The stand, which is of cast iron, 7-inches high, is attached to a wood platform 5-feet 9-inches long by 3-feet 5½-inches wide.¹

Adapter A.—This adapter, which is for use with the connecting pipes of the "Pump, air, double," is a metal casting 2.625-inches long, with connections to suit the discharge nozzle of the "Pump, air or liquid," and the unions of the connecting pipes of the "Pump, air, double."

Adapter B.—This adapter, which is for use with the connecting pipes of the “Pump, air or liquid,” is a metal casting 4.45-inches long, with connections to suit the unions of the connecting pipes of the “Pump, air or liquid.”

Pipes, connecting.—These pipes are each 10-feet long—two with unions at each end and two with a plug at one end and a union at the other.

The spanners are of steel, formed to suit the various parts of the pump, &c.

Arrangement of connecting pipes.—The pump is connected to the cylinders of mountings or to reservoirs, by means of connecting pipes, which may be either those described above or the connecting pipes of the “Pump, air, double,” whichever are available.

When the connecting pipes of the “Pump, air, double,” are used for connecting to the cylinder or reservoir through a separator, the adapter (A) is first screwed on to the discharge nozzle of the “Pump, air or liquid,” and the pipes are then connected as required.

When the pipes of the “Pump, air or liquid,” are used for connecting—

1. To the cylinder, the adapter (B) is first screwed on to the “Connection, indicator, pressure,” in use with the mounting and the pipes are then connected as required.
2. To the reservoir through a separator, three adapters (B) are first screwed on, one to the nozzle of the inlet valve, one to the nozzle of the outlet valve of the separator, and one to the nozzle of the valve of the reservoir. The pipes are then connected as required.

Method of use.—Pumping air.—When charging with air the lever working the cock is turned to the side of the tank marked “air.” On the up stroke of the cylinder air is drawn through the cock along the passages and through the suction valve into the low-pressure cylinder. On the down stroke of the cylinder the air is forced through the intermediate valve and compressed into the high-pressure cylinder, and on the next stroke of the cylinder is forced through the delivery valve and pipe to the cylinder of the mounting or reservoir.

When first commencing to pump air the area of the low-pressure cylinders can be increased and consequently a larger volume of air pumped by connecting the outer plungers to the bottom of the tank. When the pressure in the cylinder which is being charged becomes too high for the pump to be worked by this arrangement the outer plungers are connected to and move with, the cylinders. The outer plungers are connected to the tank or cylinders by moving a lever on each side of the tank towards the words “low-pressure” or “high-pressure,” respectively. *The connections must not be made until the cylinder is on the bottom stop on that side.*

Pumping liquid.—When pumping liquid the lever of the cock is turned to the side of the tank marked “liquid,” and at *high pressure* the plugs of the overflow valves are unscrewed sufficiently to allow the liquid that cannot be contained in the *high-pressure pump* to exhaust into the tank. On the up stroke of the cylinder the liquid is drawn through the suction valve into the cylinder and on the down stroke of the cylinder is forced through the intermediate and delivery valves and pipe into the cylinder of the mounting.

Belonging to the pump are four connecting pipes, four adapters—one (A) and three (B)—and four spanners, Nos. 157 to 160.

Weights, &c.

				Weight.			Tonnage.
				cwt.	qrs.	lbs.	tons.
Pump	...	...	...	3	0	0	0.3695
Stand, with platform	...	...	...	3	2	3	0.451

Maximum working pressure, 2,000-lbs. per square inch.

Mark II differs from *Mark I* generally as follows:—The tank is of an increased depth, in order to ensure the high-pressure plungers being kept wet.

The same instructions as given for the “Pump, air, double,” should be followed with this pump to ensure it being kept in a serviceable condition.

PUMP, RUNNING-BACK, PORTABLE, MARK I.

(Plate XXXI.)

This pump is used for filling the buffers, charging the intensifiers and running-back the guns on the above-mentioned carriages for attending to the packings, &c. It is also used with B.L. 9.2-inch H.A. mountings as an alternative to the hydraulic gear. It is of the ordinary double-acting hydraulic type, and is contained in a portable tank on wheels, so that it may be conveniently moved from one carriage to another.

The pump itself consists of a metal casting fitted with plungers which, when actuated by the handles, draw the liquid through the inlet valves and force it past the delivery valves through a connecting pipe into the cylinder to which it is connected.

The “Pipes, copper, connecting, $\frac{1}{4}$ -inch bore,” used with the “Pump, air, double,” are also used for connecting the portable running-back pump to the buffers, &c., of above-mentioned carriages.

Adapters are used for connecting the copper pipes to the portable pump.

Before commencing to pump a gun back the tank must be filled to a depth of 6-inches with the same description of fluid as is used in the hydraulic buffers.

When the gun is run-up to firing position the liquid is forced back again from the hydraulic buffer to the tank through a bye-pass valve. This valve must be closed before commencing to pump the gun back and opened to run up.

Weight, 5-cwt. 1-qr.

The following articles are used with the pump :—

Pump, running-back, portable (Mark I)—

Valve, stop, "A" (Mark I) ... Steel and bronze.

Adapters, pump, pipes, "C" (Mark I) ... For coupling copper connecting pipes, $\frac{1}{4}$ -inch bore to pump, running back portable and stop valve "A."

Pipes, copper, connecting, $\frac{1}{4}$ -inch bore by 10-feet—	$\left\{ \begin{array}{l} \text{External diameter, } \frac{1}{8}\text{-inch. For} \\ \text{use with pump, air, double;} \\ \text{pump, air or liquid; pump,} \\ \text{running-back, portable.} \end{array} \right.$
With unions (Mark I) ...	
With union and plug (Mark I)...	

RESERVOIR, COMPRESSED AIR, MARK II.

(Plate XXXII).

The reservoir is for keeping in reserve a supply of compressed air for recharging the air cylinders. It is in the form of a flask with a short neck at one end, strengthened by having a steel collar screwed on the outside. The neck is fitted with a stop-cock, which is used for charging and discharging the reservoir; the outer end of the cock is screwed to take the nut of the charging pipe. The stop-cock is in two pieces, so that the pressure in the reservoir can be cut off and the outer part removed when the reservoir is packed for transport.

The pressure in the reservoir should not exceed 2,000-lbs. on the square inch when in ordinary use or when travelling.

A preserving plug, valve union, valve key with gland and three grummets are issued with the reservoir.

The *Mark I* reservoir, which is not so strong as the *Mark II*, is not issued for service with these carriages.

Care and Preservation of Mark II Reservoir.—As the reservoirs have to sustain a high pressure when fully charged, it is essential that they should be periodically tested to ascertain if they are in a serviceable condition and annealed to preserve the tenacity of the material.

The testing will be carried out locally, biennially, by pumping in hydraulic pressure up to 3,000-lbs. per square inch. Any reservoirs failing to pass this test or showing any permanent set or leakage must be returned to Store for transmission to Woolwich. *Before and after* testing, the outside of the reservoir near the centre must be accurately gauged at four points and the measurements recorded on a history sheet which is supplied with each reservoir. The date of the biennial test must be stamped on the reservoir.

The reservoirs will be annealed every sixth year, for which purpose they must be returned to Store for transmission to Woolwich.

Each reservoir will have a registered number stamped on it, also the manufacturer's mark or name, the numeral of the reservoir, date of issue and annealing and test marks, with date as under :—

No. 56.
J. B. & Co.
11
1899
(A) 10.3.99.
(T) 11.3.99.

The stamping of the date of test on the reservoir must on no account be done until the pressure has been let out. A history sheet (Army Form G 881) will be issued with each reservoir. This sheet is intended to preserve a complete history of the reservoir from the date of issue from the Royal Arsenal to its final return to Store. The biennial tests and re-annealing will be recorded on this sheet and also anything calling for special remark. This sheet must always be kept with the reservoir and returned with it to Store. Report of the entries made in the sheet are to be sent to the Chief Inspector, Woolwich, through the G.O.C. on the completion of the biennial testing.

Filled reservoirs on R.A. charge should be marked with the word "filled" and with the amount of pressure in them.

Before returning reservoirs to Store, they must be first emptied and the word "empty" stencilled on them.

Reservoirs not on R.A. charge should be stored empty and so marked.

Care must be taken when removing reservoirs that they are not thrown down or roughly handled. To protect them from jar, three 4-inch tarred rope grummetts will be placed on the reservoirs; in hot climates, wadmiltits or such other suitable covering as may be available will be used, when required, to protect them from the rays of the sun.

RIMER, VENT AXIAL, SHORT.

This is of bronze and is used for clearing the tube chamber of the axial vent.

SEPARATOR, AIR PUMP, MARK I.

(Plate XXXII).

The separator is used to separate the moisture from the air during the process of pumping into the reservoir. It consists of a copper tube screwed at both ends. At one end of the copper tube a wrought iron head is fitted, furnished with inlet and outlet valves of gunmetal and a $\frac{1}{4}$ -inch copper pipe, which carries the air and water in a downward direction into the separator. At the other end of the copper tube is a wrought iron foot which is fitted with a drain-cock of gunmetal. The separator is connected up between the pump and the reservoir to be charged and the moisture of the air, while passing through the copper tube, falls to the bottom and is blown off from time to time during

the operation through the drain-cock. When the separator is used, it must be always fixed in a vertical position, the inlet and outlet valves being at the top.

SCRAPER, B.L. ORDNANCE, No. 1.

This scraper is intended for use in cleaning the chamber of guns after firing powder charges. *Mark I* consists of an ash stave with one end formed into a head, on one side of which is rivetted a steel scraper and on the other a brush. The stock of the brush is of beech, to which tufts of bristles are secured by brass wire. *Mark II* brush differs from *Mark I* in the scraper, which is of aluminium bronze instead of steel; the latter was found to be too brittle. Length, 6-feet.

STAVES.

The end stave of the piasaba brush is of ash, fitted with a metal plug to suit the socket-joint on the brush stave. The length is 16-feet.

The intermediate stave is for lengthening the piasaba brush stave. It is of ash and is fitted at one end with a metal plug and at the other end with a metal cylinder to suit the brush stave and end stave. The length is 11-feet 6-inches.

TOOL, WITHDRAWING ANTI-FRICTION WASHER.

This tool consists of a piece of steel wire having a screw thread corresponding with the threaded hole in the washer on one end and a loop formed at the other end.

TRAY, SPARE PARTS.

The tray is generally similar to the "Box, spare parts" described on page 77, and is intended to hold the spare parts of the carriages of a Work.

WRENCHES.

The following wrenches are used with the breech mechanism :—

Mark IX and "C" Mark IX Guns.

Wrenches, breech mechanism—

No. 1 ...	...	...	In 6 parts (A, B, C, D, E, F) and tommy.
No. 32	...	...	Locks, electric and percussion.
No. 34	...	...	Nut crank handle, screws and axis pins.
No. 35	...	...	Nut vent.

Marks X, X^r and X Guns.*

Wrenches, breech mechanism—

No. 20	...	...	Nut vent and small nuts and screws.
No. 36	...	...	Nuts for carrier hinge bolt and link pinion stud.
No. 37	...	...	Ball-bearing bushes, axis pin for link, fixing screws of cam and "screws fixing, bracket, catch, retaining breech mechanism lever."

AMMUNITION.

Projectiles.						Fuzes.	Cartridges.		Means of firing.
Nature.	Mark.	Bursting charge.		Approximate weight filled and fuzed.	Nature of Charge.		Weight of Charge.		
		Nature.	Weight.						
			lbs. ozs. drs.					lbs. oz.	
H.E. ...	VIII (a) ...	H.E. ...	34 9 0	380	Percussion, D.A. impact, No. 13 (c)	Cordite, M.D., 37 (e) ...	120 0	Tube, vent, sealing, electric, wireless "P" or Tube, vent, sealing, percussion.	
H.E. ...	VIII _A (a) ...	H.E. ...	33 0 0	380					
H.E. ...	IX (a) ...	H.E. ...	31 13 0	380					
H.E. ...	IX _A (a) ...	H.E. ...	31 9 8	380					
H.E. ...	IX*** (b) ...	H.E. ...	31 13 0	380					
H.E. ...	X*** (b) ...	H.E. ...	40 6 8	380					
H.E. ...	XII _A (a) ...	H.E. ...	31 8 0	380	Percussion, D.A. impact, No. 13, with adapter 2-inch fuze-hole No. 2 (c)	Cordite, M.D., 26 (e) ...	107 0		
H.E. ...	XIII (a) ...	H.E. ...	33 5 0	380					
H.E. ...	XIII/VIII (b) ...	H.E. ...	34 9 0	380					
H.E. ...	XIII/VIII _A (b), ...	H.E. ...	33 0 0	380					
H.E. ...	XIII _A ...	H.E. ...	31 12 4	380					
A.P. ...	I (a) ...	Powder	—	380					
A.P. ...	II (a) ...	Powder	—	380	Percussion, base, large, No. 11, or bronze, No. 15 or 15c				
A.P. ...	III (a) ...	Powder	18 0 0	380					
A.P. with cap	IV (a) ...	Powder	—	380					
A.P. with cap	IV* (a) ...	Powder	—	380					
A.P. with cap	V (a) ...	Powder	—	380					
A.P. with cap	VII (a) ...	H.E. ...	—	380					
A.P. with cap	VII _A ...	H.E. ...	—	380	Percussion, base, large, bronze, No. 16				
A.P. with cap	IX _A ...	H.E. ...	—	380					

A Indicates 4 calibre radius of head; other shell are 2 c.r.h.
 (a) Obsolete for future manufacture.
 (b) Converted by fitting 2-inch fuze-hole bush suitable for "Exploder container."

(c) For use with picric exploders.
 (d) For use with trotyl or C.E. exploders.
 (e) Existing cordite M.D., 37, will be replaced, as expended, by cordite M.D., 26.

AMMUNITION FOR SUB-CALIBRE GUN.

Projectiles.			Plugs.	Cartridges.			Means of firing.
Nature.	Mark.	Approximate Weight.		Nature of Charge.	Weight of Charge.	Igniter.	
		lbs. ozs. drs.			oz. dr.		
Shot, practice ...	I III IV V	6 0 0	—	{ Cordite, M.D. or R.D.B. 4½	8 11½	4 or 5-drs. R.F.G.* powder	{ Cap, Mark II. Primer, percussion, Q.F. cartridges, No. 2, Marks III or IV.
Shell, steel (annealed)		6 0 0	Base shell, No. 3				
Shell, common nose fuze		6 0 0	Fuze-hole G.S. without loop, Mark I Base shell, No. 3				
	II, N.T.						

AMMUNITION FOR RIFLES, AIMING, 1-INCH.

Description.	Mark of cartridge.	Weight of bullet.	Charge.	Means of firing.
Cartridge— Aiming rifle. 1-inch, electric	IV & V	ozs. grs. 9 408	} 400 grains, R.F.G. ² powder	Electric primer.
Aiming rifle. 1-inch, blank	I	—		

CARTRIDGE, B.L. 9·2-INCH, 60-LB., CORDITE, M.D., 37.

(Half-Charge.)

(Plate XXXIII.)

Mark III.—The empty cartridge is made of silk cloth. The charge is built up of M.D. cordite, 37, cylindrical in shape. The igniter (minimum 8-oz. R.F.G.² powder) is contained in shalloon discs, stitched to form five parallel compartments.

A millboard disc covered with silk cloth having a linen tape, labelled "Tear off," is placed over the igniter end of the cartridge. This disc is torn off before loading the gun.

A lifting becket is stitched to the bottom of the cartridge bag.

Mark I and *Mark II* differ principally from the *Mark III* in the igniter being stitched across the centre to form four compartments in *Mark I* and eight compartments in *Mark II* and in the arrangement of the beckets for lifting purposes.

Packed one in a No. 36 cartridge cylinder.

CARTRIDGE, B.L. 9·2-INCH, 30-LB., CORDITE, M.D., 37.

(Quarter-Charge.)

Marks I, II and III.—These cartridges are generally similar to the 60-lb. cartridges (half-charge), but are shorter.

Packed two in a No. 36 cartridge cylinder.

CARTRIDGE, B.L. 9·2-INCH GUN, 53½-LB., CORDITE, M.D., 26.

CARTRIDGE, B.L., 9·2-INCH GUN, 26-LB. 12-OZ., CORDITE, M.D., 26.

These charges are made up in the same way as the 60-lb. and 30-lb. charges, but of Cordite M.D., 26.

CARTRIDGE, B.L. DRILL, 9·2-INCH, 51½-LB.

The drill cartridge weighs 51-lbs. 8-ozs. and represents the Service cartridge (half-charge). It is made of wood, weighted with lead in the centre and is covered with raw hide. A lifting becket of leather is fitted at the small end and a leather loop at the large end.

CARTRIDGE, Q.F. 6-PDR., CORDITE, M.D.
PRACTICE AND SUB-CALIBRE, MARK XXV.

(Plate XXXIV.)

The cartridge consists of a *Mark III* empty case, an M.D. Cordite charge, a *Mark I* igniter, a *Mark II* cap and a shot, practice, *Mark I*.

The *Mark III* case is made of solid drawn brass, with a projecting rim at the base to prevent the case being pushed too far into the chamber and also to admit of easy extraction; a hole is bored through the centre of the base, enlarged at the lower end to take a cap chamber with cap. The case is lacquered inside and out with transparent lacquer.

The cap is made of copper and contains 1·2-grains of cap composition, pressed in, varnished and covered with a tinfoil disc and is secured in the cap chamber; the latter is made of brass with a raised anvil with three fire holes.

The charge consists of a bundle of M.D. cordite $4\frac{1}{4}$, 8-ozs. $11\frac{1}{2}$ -drs., cut about 9·5-inches long, tied together with silk or cotton sewing. Two fins each containing 1-dram of cordite cut 2·5-inches long, tied loosely in the middle, pass through the charge (at right angles to each other) to keep it central in the case.

The igniter consists of 5-drams of R.F.G.² powder contained between two discs of shalloon, secured to the base of the charge by silk sewing.

The shot is secured in the case by three indents round the neck of the latter indented into the cannellure formed below the driving band.

CARTRIDGE, AIMING RIFLE, 1-INCH, ELECTRIC, CORDITE, LEAD BULLET,
MARK I.

Consists of a case, electric primer, charge and bullet.

The case is made of solid drawn brass with a hole in the base tapped to receive the primer; it is lacquered internally except the part that envelops the bullet and the threads of the primer hole.

The primer consists of a brass body having an enlarged head; the body is screw-threaded near the head to screw into the case; the head fits into a recess, a fibre washer making a tight joint. The body is bored out, the metal being thinned at the front end.

Fitted into the body is a brass contact pin, insulated from the body by two ebonite plugs, the front plug being coned to suit the coned seating in the primer. An iridio-platinum wire bridge is soldered with pure tin to the front of the contact pin and the front edge of the body. Two slots are cut in the head for the key inserting or removing primer. A paper cylinder is secured outside the plain part of the body by shellac varnish. The body of the primer is filled with guncotton yarn and the mouth closed by a glazeboard disc pressed in. The paper tube is charged with 14-grains of pistol powder and closed by a glazeboard disc, the end of the tube being turned over and secured with shellac.

The charge consists of 160-grains of cordite 3, cut about 2·4-inches long and tied near the front end by a single tie of silk sewing.

The bullet is made of an alloy composed of 98 parts lead and 2 parts antimony; two cannellures are formed around it and are filled with pure

beeswax ; the base is reduced in diameter to receive a copper cup which is made of solid drawn copper and pressed in.

CARTRIDGE, AIMING RIFLE, 1-INCH, ELECTRIC, BLANK, MARK I.

This cartridge consists of the Service charge and *Mark IV* Morris pattern case and primer, the charge being covered by two asbestos discs, which are coated with Pettman cement on the top and edges.

The mouth of the case is turned in.

Packed 12 in a bundle, 8 bundles in a box.

SHELL, B.L. ARMOUR-PIERCING, 9.2-INCH.

(Plate XXXV.)

Mark III is of forged steel with a pointed head, and the base prepared to take the "Fuze, percussion, base, large, No. 11" or "No. 15."

The shell is fitted with a gascheck driving band, in a groove having waved ribs to prevent the band turning.

Mark II differs from *Mark III* in the groove for driving band not having waved ribs.

Mark I differs from *Mark II* in the form of the lower part of the driving band.

SHELL, B.L. ARMOUR-PIERCING, WITH CAP, 9.2-INCH.

Mark V differs principally from the *Mark III* "Armour-piercing shell" in being fitted with a cap over the point and in having a plain copper driving band.

Mark IV differs from *Mark V* in being fitted with a gascheck driving band. When rebanded with a plain copper driving band a star will be added to the numeral.

Mark VIIA differs from *Mark V* in having an adapter large enough to admit the use of a container of unconstricted diameter and in being fitted with a gascheck plate in the base.

Mark VII differs from *Mark VIIA* in the head being struck at a different radius.

Mark IXA differs from the *Mark VIIA* in being fitted with a smaller base plate and gascheck plate.

The base cover plate is secured in the adapter of the shell by two fixing screws from the base instead of by a fixing screw through the wall at the base of the shell.

SHELL, B.L. HIGH EXPLOSIVE, 9.2-INCH, HEAVY.

(Plate XXXVI.)

The *Mark VIII* shell is made of forged steel with a head struck at a radius of two diameters, and with a cavity tapering towards the base. It is fitted with a G.S. fuze-hole bush.

The shell is provided with a "hump" driving band pressed into an undercut groove near the base. The groove is provided with waved ribs, across which chisel cuts are made at intervals in order to prevent the band from turning.

A steel plate disc is screwed centrally into the base of the shell.

The *Mark VIIIA* differs from the *Mark VIII* in the head being struck at a different radius.

The *Mark IX* differs from the *Mark VIII* in the base being bored and screwed to take an adapter.

The *Mark IXA* differs from the *Mark VIIIA* in the shape of the tapered cavity and in the base being bored and screwed to take an adapter instead of being fitted with a steel plate disc.

The *Mark IX**** is converted from the *Mark IX* by removing the existing fuze hole socket and fitting a metal or mild steel 2-inch fuze hole socket suitable for use with a steel exploder container.

The *Marks XIII/VIII, XIII/VIIIA and X**** are similarly converted from the *Marks VIII, VIIIA and X*.

The *Marks XIIA, XIII and XIII A* are generally similar to the *Marks IXA, VIII and VIIIA* respectively, but are provided with 2-inch fuze holes suitable for use of exploder containers.

Note.—Filled H.E. shell set aside for practice will be distinguished by two black bands painted round the body in such a manner as will give the impression of a yellow band between them.

Adapter No. 2.

The No. 2 Adapter is used to adapt H.E. shell with 2-inch fuze hole to the G.S. gauge; it can be made of metal, steel or iron, and has a tapered flange on the exterior, below which it is screwed to suit the 2-inch fuze hole, leaving a plain portion at the bottom. It is bored through the centre and screwed to the G.S. fuze hole gauge.

SHOT, PRACTICE, B.L. 9·2-INCH, HEAVY.

(*Plate XXXVII.*)

Mark V is made of cast steel. It is fitted with a driving band similar to the H.E. shell described above.

Mark IV is cast solid and fitted with gascheck driving band and No. 1 augmenting ring.

SHOT, PAPER, EMPTY, B.L. 9·2-INCH, FRONT AND REAR.

Mark V is made up in four parts, each consisting of a cylinder of wood pulp choked at top and bottom with elmwood discs, the bottom disc being weakened by holes partially bored through it so that it may break up on firing.

The total weight of the shot is 428-lbs., each portion weighing 107-lbs., being filled with "shot waste, 1 to 5," and sawdust, the filling being done through a hole in the top disc, which is then closed by a wood plug.

The cylinders forming a shot are marked "Front" and "Rear," and are used as their names imply. The part marked "Rear" has its bottom disc larger in diameter than the bore and is in consequence stopped on ramming home, when its rear end reaches the commencement of the bore in order that the shot may not be rammed home too far.

Marks I to IV were in two parts only, and were made—*Mark I* of brown paper, *Mark II* of papier maché, and *Marks III and IV* of wood pulp.

Shot of the earlier Marks will be used up, but the number of portions per round will be four, as in the case of *Mark V*, and each portion will be adjusted to the weight of 107-lbs. by employing a larger quantity of sawdust to waste shot in filling.

The shot are to be fired with powder charges only.

As they break up on firing the small shot travel but a short distance (about 200-yards), while the effect, for the purposes of testing recoil, &c., is practically the same as that obtained with Service projectiles. They will therefore be issued in time of peace, when the use of Service projectiles would be dangerous or inconvenient.

There will, no doubt, be emplacements from which, owing to the close vicinity of houses it may be undesirable to use these shot in the normal line of fire. In these cases it will often be found possible, owing to the very short range of the paper shot, to find sufficient space to the right or left of the regular range to carry out such test practice as may be required.

Mark I shot should not be used unless the range is clear for 1,000 yards; but the other Marks may be used with a range clear up to 400-yards.

SHELL, DRILL, B.L. 9·2-INCH.

This is of cast-iron fitted with two copper bands to prevent injury to the rifling in loading and unloading. The nose is bushed with gunmetal and the base is fitted with a large hollowed and flanged nut of gunmetal. A gunmetal ring is fitted round the base by being screwed on; a groove is formed between it and the metal of the shell to take a rope grummet, which prevents the shell being rammed too far home. It is weighted up with sand to an average weight of 380-lbs. The shell can be extracted from the gun by hooking the shell extractor on the cross bar of base plug.

No more drill shell for the 9·2-inch will be made.

Where 9·2-inch drill shell are not already provided a Service cast-iron common nose-fuzed shell per gun will be set apart for drill purposes and marked "Drill" in 1-inch white letters round the nose to ensure the same shell being always used.

RINGS, AUGMENTING, B.L. 9·2-INCH, PROJECTILE.

No. 1 *Mark I* and No. 1A *Mark I* are for use with projectiles banded to design R.L. 10,862, except *Mark I* practice shot.

The augmenting rings are copper split rings.

Instructions for fitting augmenting rings.—Remove the grummet from the projectile and place the latter on its side with the base slightly raised. The projectile should be placed in a block No. 3 if available.

See that the groove into which the ring fits is free from burrs; if any are found they must be removed with a smooth file.

Spring the ring over the base of the projectile and into the groove. Should it appear that the gascheck has been pressed down so that the ring will not fit into its place, the ring must be removed and the groove rectified with the "Tool, rectifying gascheck."

When the groove is rectified place the ring and commencing at one end, work round it, driving it home into its seating with a wood drift and mallet, securing it by striking the lip of the gascheck in five or six places with a blunt chisel (the edge held parallel with the axis of the projectile), so that a small portion of the metal is turned over the ring, taking care to damage the gascheck part of the band as little as possible. There should be an "indent," one close on each side of the split in the ring, the remainder spaced equally so as to secure the ring firmly.

Replace the grummet on the projectile, and when single grummetts are used, lace them together in three places, equidistant from each other, with spun yarn threaded through the grummet.

FUZE, PERCUSSION, BASE, LARGE, No. 11.

(Plate XXXVIII.)

This fuze is for use with uncapped armour piercing shell.

Marks VI and V fuzes differ from the "Fuze, percussion, base, large, bronze, No. 15, *Marks IV and III* respectively," described on page 98, in being made of metal instead of bronze.

Mark IV consists of the following parts:—Body, needle pellet, centrifugal bolt, pressure plate with spindle and nut, steel protecting plug, screwed cap with detonator and magazine, phosphor bronze spring, brass spiral springs and four screws.

The body is turned and screwed on the exterior to suit the shell. The interior is bored out to receive the needle pellet and threaded at the top to receive the screwed cap. A hole is bored in the base for the spindle of the pressure plate to pass through; a recess is also formed in the base to take the pressure plate and protecting plug. A hole is bored through the side of the body and is closed with a brass screw plug, with the end reduced to form a seating for a brass spiral spring, which keeps the centrifugal bolt in position; a recess is also made in the opposite side of the body, in which the small end of the centrifugal bolt engages. Two elongated holes are made in the base for screwing the fuze into the shell.

The needle pellet is cylindrical in form and rests on the bottom of the recess in the body. It is reduced at the top end to form a seating for the spiral spring, which prevents the pellet working forward during flight. A hole is bored at right angles to the axis to take the centrifugal bolt; a hole is also bored longitudinally to take the spindle and nut of the pressure plate and the upper part is threaded to receive the needle plug. The pellet is prevented from turning by a slot in the side engaging with a pin projecting from the side of the body.

The centrifugal bolt is cylindrical in form and fits in the hole in the needle pellet; one end is reduced in diameter to fit in the hole inside the body made to receive it. An elongated hole is bored through it, and the upper surface on one side is recessed for the nut on the pressure plate spindle to engage in, thus locking the bolt till the pressure plate is crushed in.

The pressure plate has a boss on one side into which the spindle is screwed; it fits in an undercut recess in the base of the fuze.

The protecting plug is perforated with eight holes and fits in an undercut recess over the pressure plate in the base of the fuze. It is intended to protect the pressure plate from accidental blows.

The screwed cap is in two parts, screwed together, the two parts forming a magazine containing a perforated R.F.G.² powder pellet. A recess is made in the underside to receive the detonator which is spun in and six fire-holes are bored to convey the flash to the powder. A locking screw through the body of the fuze prevents the cap from unscrewing.

Weight of fuze, 2-lbs. 8-ozs.

The fuzes are issued, wrapped in brown paper, one in a tin cylinder.

Action.—On discharge the gas acting through the holes in the protecting plate causes the pressure plate to be crushed in, carrying forward the spindle and nut, thus releasing the centrifugal bolt. The rotation of the shell causes the centrifugal bolt to fly outwards, leaving the needle pellet free to move forward. On impact or graze the pellet is carried forward, the spiral spring is compressed, the needle fires the detonator and ignites the powder in the magazine, the flash of which passes through the holes in the cap and into the shell.

Mark III differs from *Mark IV* in having less protrusion of the centrifugal bolt into the body.

Mark II differs from *Mark III* in having no steel protecting plate.

Mark I differs from *Mark II* in the form of recess for the pressure plate, the shoulder of which is not so much cut away. The fuze is less sensitive since the pressure plate offers greater resistance.

Fuzes of early Marks (except *Mark II*), when converted to the *Mark IV* pattern, will have a star added to the numeral.

FUZE, PERCUSSION, D.A., IMPACT, No. 13, MARK V.

(Plate XXXIX.)

The fuze consists of the following principal parts:—Body, safety cap with securing pin, steel hammer with screwed collar and shearing pin, detonator plug, with mealed powder detonator and brass collar.

The *body* is bored throughout its length, and in its centre is screwed a steel plug recessed on the upper side to take one grain of mealed powder enclosed between two discs of tinfoil held in position by a small screw collar.

Leading from this recess are four conical fire holes filled with pistol powder and closed on the underside by a disc of paper. The lower portion of the body is filled with R.F.G.² powder retained in position by a brass disc spun in.

In the upper part of the fuze, suspended by means of a steel shearing pin, is a steel hammer, the lower part of which is reduced in diameter and is directly over the recess in the plug. The top of the hammer is also reduced in diameter, over it fits a screwed collar; a brass disc placed on top of the collar and spun into position prevents the ingress of damp.

The *safety cap* is of manganese bronze, and has two T-shaped slots to engage with brass pins in the head of the fuze, and is further secured

by two securing pins which fit into vertical holes in the cap and body. The pins are connected by copper wire, which is held to the cap by a brass strip bent over it.

Action :—Before loading the securing pins and safety cap are removed. On impact the hammer is driven in, shearing the pin, firing the mealed powder detonator, and the flash passes through the detonator plug into the magazine.

Mark IV differs from above in having a securing pin which passed horizontally through the sides of the cap and body.

In the *Mark III* fuze the head was entirely covered with a thin brass disc instead of only the top of the hammer.

Mark II fuze differs from the *Mark III* in having a thicker brass disc.

Mark I fuze had the top covered with paper instead of a brass disc.

FUZE, PERCUSSION, BASE, LARGE, BRONZE, No. 15.

(Plate XL.)

This fuze is for use with armour-piercing shell.

Mark IV consists of the following parts :—Aluminium bronze body, detonator pellet, centrifugal bolt, copper pressure plate, perforated steel plug, locking pellet, small retaining bolt, retaining bolt for pea ball, pea ball, detonator plug, detonator, screwed cap with needle, phosphor bronze spring, two brass springs, four screwed plugs for body, set screw and screwed pin.

The body is turned and screwed on the exterior to suit the shell. The interior is bored out and screwed, the bottom of the bore being coned and recessed for the detonator pellet. A hole is bored through the side of the body to receive the small end of the centrifugal bolt and closed by a screwed plug. A hole is also bored through the opposite side of the body to receive the small retaining bolt and closed by the screwed plug. A third hole is bored and screwed at an angle of 45° to the first hole to receive the screwed pin for detonator pellet. Further holes are bored, one to receive the retaining bolt for pea ball and two others longitudinally for the channel for powder pellets and pressure plate. A hole is also bored from the powder pellet channel to the centre of the body. The top of the body has a circular recess for a compressed powder ring and two elongated slots are cut in the base of the body for screwing the fuze into the shell.

The interior of the detonator pellet is bored and screwed at the top to receive a detonator plug and a flash hole is bored through. A hole is bored at right angles to the axis for the centrifugal bolt and further holes for the brass pin of the centrifugal bolt and locking pellet. The exterior of the pellet at the top is recessed to form a seating for the spring, and the bottom is reduced in diameter, forming a cone and stem, to suit the body of the fuze. A slot in the pellet engaging with a pin screwed into the body of the fuze prevents the pellet turning.

The pressure plate is cupped, having a lip round the edge to form a gascheck. A portion of the stem is reduced in diameter to enter the slot in the small retaining bolt.

The steel plug is perforated with four holes, and is secured in the recess in the base below the pressure plate by centre punch dabs. The underside is coated with rubber solution.

The detonator contains about three grains of composition.

The screwed cap has a curved top and the lower part is reduced in diameter to suit the top of the body. The bottom is reduced in diameter to accommodate the spring, and has a steel needle firmly embedded in and projecting beyond it. Six holes are bored through the flange of the cap and a hole bored and screwed for the set screw—the latter for fixing the cap.

The centrifugal bolt is fitted with a brass pin, which engages in a hole in the detonator pellet to prevent the bolt turning. A flash hole is bored through the stem of the bolt.

The small retaining bolt prevents any movement of the centrifugal bolt.

The pea ball seals the channel in the body containing the powder pellets, and is held in position by its retaining bolt.

Weight of fuze, 2-lbs. 10-ozs.

The fuzes are issued, wrapped in brown paper, one in a tin cylinder.

Action.—On discharge the pressure of the gas crushes in the pressure plate causing the spindle to release the small retaining bolt, and consequently the centrifugal bolt; the rotation of the shell causes the latter bolt to spin out, leaving the detonator pellet free. On impact the detonator pellet moves forward on to the needle and is locked by the locking bolt. The flash from the detonator passes through the central channel of the pellet and hole in the centrifugal bolt, and so to the channel containing the powder pellets, the pea ball retaining bolt and ball having previously spun out owing to the rotation of the shell. The powder pellets burn up through the body to the compressed powder ring in the top, when the flash passes through the holes in the cap and into the shell.

The *Mark III* fuze differs from the *Mark IV* only in the position of the vertical channel containing the powder pellets, which in the case of the later Marks is so altered that it is not under one of the key slots in the head.

Marks I and II fuzes are similar internally to the "Fuze, percussion, base, large, No. 11, *Mark IV*," except that they are made of bronze. *Mark II*, however, has a cupped pressure plate and steel plug (with four holes only), and is slightly longer.

No. 15c fuzes are converted from No. 16.

FUZE, PERCUSSION, BASE, LARGE, No. 16.

This fuze is similar to the No. 15 fuze, except that the steel protecting plug over the pressure plate is replaced by a steel ring.

FUZE, PERCUSSION, D.A. IMPACT, No. 45, MARK II.

(Plate *XLI*.)

The fuze consists of the following parts:—Body with brass pins, holder, screwed collar, detonator cap, safety pin, shutter, hammer, base plug, securing pins, safety cap, shearing pin and detonator.

The *body* is screwed externally below the head to the G.S. gauge, leaving a plain portion at the end. It is bored out internally to form two compartments leaving a diaphragm which has a hole bored centrally, having a thin metal partition on the upper side; this hole is filled with C.E. stemmed in and covered with a fine paper disc. A C.E. pellet is placed in the lower compartment and the base closed by a small plug having a shallow disc on its inner surface which is screwed in.

The *shutter* is a flat piece of metal of irregular shape, with two holes, one through which the pivot pin passes and secures it, and the other, which is stemmed with C.E., comes over the central channel when the shutter is open. A recess is formed on the underside to accommodate one arm of the shutter spring and a semicircular hole to form a bearing for the safety pin is drilled in the side. The spring is made of wire with two arms, one fits in the shutter and the other against the wall of the fuze.

The *holder* is screw-threaded for a portion of its length to fit in the body, the lower end being plain and reduced in diameter. It is bored out internally, recessed at the bottom and screw-threaded to house the detonator cap. A hole is drilled through the base and filled with loose C.E. stemmed in, the bottom being closed with a tycoon disc secured with shellac.

The *top* is screw-threaded and recessed to take the screwed collar and hammer, holes being bored across the axis for the shearing wire. The hammer is made of steel having a needle point at one end, it is fitted in the holder and secured by the shearing pin and collar, the centre of which is closed by a brass disc. Holes are bored through the collar and holder to accommodate the safety pin, and through the body and holder to allow the escape of gas should the detonator be fired prematurely.

The *safety cap* is made of manganese bronze and attached by T-shaped slots to engage pins on the body, it is provided with a milled edge and has two holes drilled through it.

A slot or recess is provided at the top to take the fuze key. The securing pins are made of copper double pronged, and are connected with each other by means of a twisted wire loop.

Action.—Before loading, the securing pins, cap and safety pin are removed. Nothing happens on the shock of discharge, on acceleration in the bore the shutter would probably remain closed. During flight the rotation of the shell causes the shutter to swing open, overcoming its spring and bringing the hole in it in line with the central channel. On impact the hammer fires the detonator and functions the fuze.

When not in shell the fuzes are packed one in a cylinder, 50 in a case wood packing.

Weight without cap, 10-ozs. 3-drms.

FUZES, DRILL.

The drill fuzes resemble, generally, the Service fuze which they represent and in some cases burnt out fuzes are used for this purpose.

To facilitate identification the drill fuzes are stamped "Drill" and bronzed.

TUBE, V.S. ELECTRIC, WIRELESS, P, MARK VI.

(Plate XLII.)

The body is made of solid drawn brass, the interior is bored out and takes a charge of rifled pistol powder. Above this the walls are thicker, forming a seating for a copper sealing plug. A screw-threaded recess in the head of the tube is fitted with an ebonite cup. An insulated copper wire passes through the sealing plug and cup; the bared end of the wire is coiled above a copper washer and the hollow of the cup is filled with a contact piece of tin and antimony. At the lower end of the plug the projecting end of the wire is bared and has soldered to it an iridio-platinum bridge giving a resistance of 0.9 to 1.1 ohms. The other end of the bridge is soldered to a small pole-piece attached to the copper plug. The lower end of the plug is shaped to act as a gascheck. A small charge of priming composition is placed round the bridge and kept in position by a perforated glazeboard disc. The bottom of the tube is closed by a cork plug and paper discs.

TUBE, VENT-SEALING, PERCUSSION.

(Plate XLIII.)

Mark VII consists of a body, cap, cap holder, striker, brass washer, copper shearing wire, striker holder, two paper discs and a cork plug.

The body is of brass; the head is bored centrally to receive the cap and striker; the front end of this recess is formed into a raised anvil, through which two fire channels are bored. The cap is held in position on the anvil by the cap-holder, and above the latter is screwed the striker-holder, in which the striker is secured by a copper shearing wire. The striker is further secured by being riveted at its outer end to a brass washer.

The lower part of the tube is filled with 32-grains of rifled pistol powder. The tube is closed with a paper disc and cork plug which is coated with varnish and further secured by the end of the tube being burred over.

Percussion V.S. tubes of present manufacture are blackened all over and have four notches cut in the rim of the head to distinguish them by sight or touch from wireless electric tubes.

Action.—On firing the gun the point of the striker of the percussion lock drives the striker of the tube, together with the cap, on to the anvil, thus firing the tube.

The *Mark IV* differs from the *Mark VII* as follows:—

The striker has no needle point.

There is no copper cap to act as a gascheck.

There is no shearing wire.

The anvil carries a percussion cap and has three fire holes.

There is no recess under the brass washer on the outer end of the striker.

These tubes are packed 10 in a tin box.

Notes.

In the event of the tube failing to ignite a charge, care should be

taken in extracting the fired tube, not to stand directly in rear of the gun, as the gas generated will cause the tube to fly out with some violence when eased by the extractor.

TUBES, VENT-SEALING, PERCUSSION, DRILL.

Mark II is of gunmetal and of the same external dimensions as the Service V.S. percussion tube; the body is blackened all over, four longitudinal grooves are cut in the body and the rim of the head is milled to distinguish it by sight or touch, from other tubes.

Internally it is bored out and fitted with a cone plug of rubber secured in position by a gunmetal plug screwed in the front end.

Mark I differs from *Mark II* in being much shorter and in not being blackened, grooved or milled.

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- Railways. 4s. (3s. 6d.)
- Surgical Cases Noted. 7s. 6d. (6s. 8d.)
- Telegraph Operations. 10s. (8s. 6d.)
- Voluntary Organizations in aid of the Sick and Wounded. Report of the Central British Red Cross Committee on. 1902. 3s. (2s. 5d.)

SPECIAL RESERVE. (See also ENTRANCE; EXAMINATION; RESERVE) :—

- Regulations for Officers of the Special Reserve of Officers, and for the Special Reserve. 1911. 4d. (5d.)
- Scheme for the Provision, Organization, and Training of the Special Reserve required to supplement the Regular Army, and the Application of the Scheme to the existing Militia. Special A.O., Dec. 23, 1907. 2d. (2d.)

MILITARY BOOKS, published by Authority—continued.

(As to prices in brackets, see top of page 2.)

- STAFF COLLEGE, CAMBERLEY, REGULATIONS.** April 1921. 1d. (2d.)
- STATIONS OF UNITS OF THE REGULAR FORCES, MILITIA, SPECIAL RESERVE, AND TERRITORIAL FORCE.** Quarterly up to No. 45, July 1914. Each 2d. (4d.) (*Subsequent publication suspended.*)
- STATUTES** relating to the War Office and to the Army. 1880. 5s. (4s.)
- STATUTORY POWERS** of the Secretary of State, Ordnance Branch. 1879. 5s. (4s. 4d.)
- STEAM ENGINES AND BOILERS AND GAS AND OIL ENGINES.** Management of. Notes and Memoranda. 1911. 1d. (2d.)
- SUDAN ALMANAC.** 1922. Compiled in the Intelligence Department, Cairo. Astronomical Calculations made in the Computation Office of the Survey Department, Egyptian Ministry of Finance. 1s. 6d. (1s. 4d.)
- SUDAN. BRITISH FORCE IN THE.** Standing Orders. 1914. 9d. (9d.)
- SUDAN.** The Anglo-Egyptian. A Compendium prepared by Officers of the Sudan Government :—
 Vol. I. Geographical, Descriptive, and Historical (*with Eighty-two Illustrations*). 10s. (7s. 4d.)
 Vol. II. Routes. 7s. 6d. (5s. 5d.) (*Not including Chapter VII., Supplement (A).*)
 Vol. II. Routes. In Separate Chapters. 1s. (10d.) each :—
 I and II., Nil. III. North-Eastern Sudan. IV. Eastern Sudan.
 V. Central Sudan. VI. South-Eastern Sudan. VII. Bahr-el-Ghazal.
 VIII. Kordofan. IX. North-Western Sudan.
 Ditto. Chapter VII. Supplement (A). Bahr-el-Ghazal. Additional Route. 1s. (10d.)
- SUDAN CAMPAIGN.** History of the. Two parts, and Maps. 1890. 15s. (12s. 3d.)
- SUPPLY MANUAL (WAR).** 1909. 6d. (7d.)
- SUPPLY, REORGANIZED SYSTEMS OF,** and of Ammunition Supply of the Expeditionary Force in War, consequent on the Introduction of Mechanical Transport. Memorandum explaining the. Feb. 1912. 1d. (2d.)
- SUPPLY, TRANSPORT, AND BARRACK SERVICES.** Regulations. 1915. 6d. (7d.)
- SURVEYING.** Topographical and Geographical. Text Book of. Second edition. 1913. 7s. 6d. (6s. 8d.)
 Ditto. 1905. Appendix XI. Tables for the Projection of Graticules for squares of 1° side on scale of 1 : 250,000, and for squares of ½° side on scale of 1 : 125,000; with other Tables used in Projection Maps. 4d. (5d.)
 Ditto. 1905. Appendix XII. Tables for the Projection of Graticules for Maps on the scale of 1 : 1,000,000. 1910. 2d. (2d.)
- TACTICAL RIDES AND TOURS ON THE GROUND.** The Preparation and Conduct of. Translated from the German. 1s. 3d. (1s. 2d.)
- TECHNICAL PAPERS.** 1. Approximately Rigorous Adjustment of Simple Figures (with Diagrams). June 1919. 2s. 6d. (2s.)
- TELEGRAPHY AND TELEPHONY.** Army. Instruction in :—
 Vol. I. Instruments. 1908. (Reprinted, with Corrections, 1914.) 1s. 6d. (1s. 6d.)
 Vol. II. Lines. 1909. (Reprinted, with Corrections, 1914.) 1s. (1s.)
 Ditto. Revised Chapter I. Field Cables. Provisional. 1d. (2d.)
 Ditto. Amendment, April 1918. Revised para. 67. 1d. (2d.)
- TERRITORIAL FORCE.** (*See also EQUIPMENT and EXAMINATION*) :—
 Annual Return for Year ending Sept. 30, 1920. 4s. (3s. 2½d.)
 Cadet Infantry Training. Manual of. (*Reprinted, 1921.*) 1s. (10d.)
 Cadet List. 1922. A List of Cadet Units which have received Official Recognition up to Dec. 31, 1921. 6s. (4s. 9½d.)
 Cadet Units in the British Isles. Regulations governing the Formation, Organization, and Administration of. 1921. 3d. (3d.)
 Field Kits. Officer and Men. 1d. (2d.)
 Hospitals, General, of the. Regulations for. 1912. 2d. (4d.)
 Medical Corps. Royal Army. Syllabus of Training. 1914. 1d. (2d.)
 Mobilization of a Territorial Infantry Battalion. (*Reprinted from THE ARMY REVIEW, July 1913.*) 3d. (5d.)
 Nursing Service. Standing Orders. 1912. (Reprinted, with Amendments, 1914.) 1d. (2d.) *See also HOSPITALS and NURSING SERVICE.*
 Pay duties during Embodiment. Instructions in. 2d. (3d.)
 Regulations for the (including the Territorial Force Reserve) and for County Associations. 1912. (Reprinted, with Amendments published in Army Orders to Dec. 1, 1914.) 6d. (9d.)
 Voluntary Aid :—
 Scheme for the Organization of, in England and Wales. Dec. 1910. (Out of print)
 Ditto. Ditto. Amendments. 1d. (1d.)
 Ditto, in Scotland. Oct. 1911. 2d. (4d.)
 Ditto. Ditto. Amendments. 1d. (2d.)

MILITARY BOOKS, published by Authority—continued.

(As to prices in brackets, see top of page 2.)

TRACTOR TRIALS held by the Experimental Sub-Committee of the Mechanical Transport Committee at Aldershot, Sept. and Oct. 1903. Report on. 6d. (6d.)

TRAINING AND MANOEUVRE REGULATIONS. 1913. 4d. (5d.)

TRAINING MANUAL FOR ROYAL ARMY MEDICAL CORPS TERRITORIAL FORCE CADETS. (Provisional.) Sept. 1920. 2s. 6d. (1s. 11d.)

TRANSPORT. MECHANICAL :—

Heavy Pontoon Bridge for use by. 1914. Provisional. 2d. (3d.)

Regulations for the Appointment of Inspectors of. 1d. (2d.)

TRANSPORT. PACK. Notes on. (Reprinted, with Amendments, 1916.) 1d. (2d.)

TROOPS. See MOUNTED and NUMBER.

TRUMPET AND BUGLE SOUNDS for the Army. With Instructions for the Training of Trumpeters and Buglers. 1914. 9d. (10d.)

Ditto, Amendments, July 1917. 1d. (2d.)

TYPE EXERCISES. See SCHOOLS.

TYPHOID (ANTI-) COMMITTEE. Report. 1912. 2s. 6d. (2s. 2d.)

TYPHOID (ANTI-) INOCULATION COMMITTEE. Report on Blood Changes following Typhoid Inoculation. 1905. 1s. 6d. (1s. 4d.)

URDU-ENGLISH PRIMER. For the use of Colonial Artillery. 1899. 15s. (11s. 5d.)

VALISE EQUIPMENT. Instructions for Fitting :—

Bandolier pattern. 1903. 2d. (2d.)

See also EQUIPMENT.

VALPARAISO. The Capture of, in 1891. 1s. (11d.)

VENEREAL DISEASE. See MEDICAL SERVICES.

VETERINARY CORPS. Royal Army. Standing Orders. 1920. 6d. (6d.)

VETERINARY MANUAL (WAR). 1915. 1d. (1d.)

VETERINARY SERVICES. Army. Regulations. 1906. (Reprinted, with Amendments to Dec. 31, 1917). 3d. (3d.)

VOLUNTARY AID. See TERRITORIAL FORCE.

VOLUNTEER ACTS, 1863, 1869, 1895, 1897, and 1900, except where repealed. Reprint of : Extracts from Regulation of the Forces Acts, 1871 and 1881, and Reserve Forces Acts, 1890; and Order in Council of February 5, 1872. 1d. (2d.)

VOLUNTEER LIST. Oct. 1919. 1s. 6d. (1s. 4d.)

WAR GRAVES COMMISSION. IMPERIAL :—

The Graves of the Fallen. Descriptive Account, by Mr. Rudyard Kipling, of the Work of the Commission; Illustrations, by Mr. Douglas Macpherson, showing the Cemeteries and Memorials as they will appear when completed. 6d. (6d.)

War Graves. How the Cemeteries Abroad will be Designed. Report, Nov. 14, 1918, by Lieut.-Colonel Sir Frederic Kenyon, K.C.B., Director of the British Museum. 3d. (4d.)

WAR OF 1 14-20 :—

Despatches (Naval and Military) relating to Operations in the War :—

I. Sept., Oct., and Nov. 1914. With List of Honours and Rewards Conferred. (Reprinted 1921.) 1s. 6d. (1s. 4d.) (With Sketch Map.)

II. Nov. 1914 to June 1915. With Names of Officers Mentioned, and Awards of the Victoria Cross. 6d. (8d.)

III. July to Oct. 1915. With names of Officers and Men mentioned, and Awards of the Victoria Cross. 3d. (5d.)

IV. Dec. 11, 1915, from General Sir Ian Hamilton, G.C.B., describing the operations in the Gallipoli Peninsula, including the Landing at Suvla Bay. 2d. (4d.)

V. Jan. to April 1916. With Names of Officers and Men mentioned, and Awards of the Victoria Cross. 6d. (8d.)

VI. May to Dec. 1916. With Names of Officers and Men Awarded the Victoria Cross. 1s. (1s. 1d.)

VII. Dec. 1916 to July 1917. With Names of Officers and Men Awarded the Victoria Cross. 9d. (10d.)

VIII. July 1917 to June 1918. With Names of Officers and Men Awarded the Victoria Cross. 1s. (1s. 5d.)

IX. July to Dec. 1918. With Names of Officers and Men Awarded the Victoria Cross. 1s. (11d.)

X. Jan. 1919 to Jan. 1920. With Names of Officers and Men Awarded the Victoria Cross. 2s. (1s. 11d.)

History of the War :—

Medical Services :—

General History. Vol. I. 21s. (16s. 9d.)

Diseases of the War. Vol. I. 21s. (16s. 9d.)

Surgery of the War. Vol. I. 25s. (19s. 9d.)

Military Effort of the British Empire during the Great War. Statistics of the March 1922. 10s. 6d. (9s. 2d.)

Parliament's Vote of Thanks to the Forces. Speeches delivered in the Houses of Parliament, Westminster, on Oct. 29, 1917. 1d. (1d.)

MILITARY BOOKS, published by Authority—continued.

(As to prices in brackets, see top of page 2.)

WAR OFFICE LIST, AND ADMINISTRATIVE DIRECTORY FOR THE BRITISH ARMY. 1922. Sold by *Harrison & Sons, Ltd., 44-47, St. Martin's Lane, W.C.2.* 17s. 6d. net. (Postage 5d.)

WATER SUPPLY MANUAL. 1s. 6d. (1s. 5d.)

WOMEN'S WAR WORK in maintaining the Industries and Export Trade of the United Kingdom. Information officially compiled for the use of Recruiting Officers, Military Representatives, and Tribunals. Sept. 1916. Illustrated. 1s. (1s.)

WORKS MANUAL. (WAR.) 1913. Provisional. 4d. (4d.); Appendix I, 1914. 1d. (1d.)

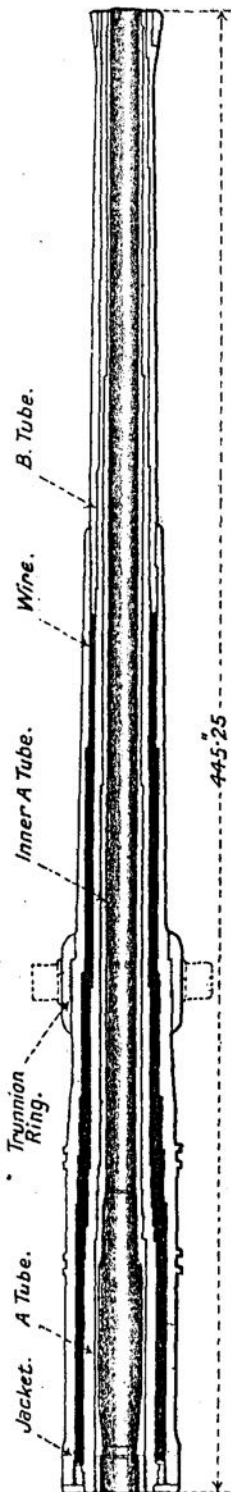
WOUNDS OF WAR. General Principles guiding the Treatment of. Conclusions adopted by the Inter-Allied Surgical Conference held in Paris, March and May 1917. 2d. (3d.)

YEOMANRY AND MOUNTED RIFLE TRAINING. Parts I and II. 1912. (Reprinted, with Amendments, 1915.) 6d. (7d.)

ZULU WAR OF 1879. Narrative of the Field Operations connected with the. 1881. (Reprinted 1907.) 3s. (2s. 10d.)

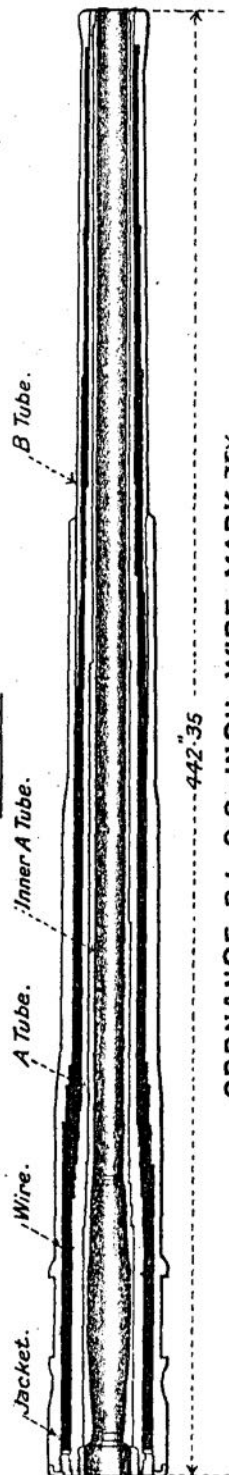
ORDNANCE, B.L. 9.2-INCH, WIRE, MARK IX.

Scale = $\frac{1}{32}$ approx.



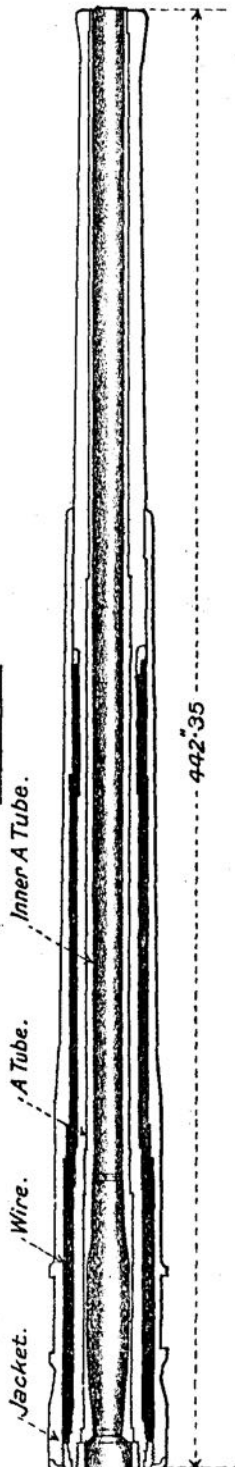
ORDNANCE, B.L. 9.2-INCH, WIRE, MARK X.

Scale $\frac{1}{40}$.



ORDNANCE, B.L. 9.2-INCH, WIRE, MARK X.

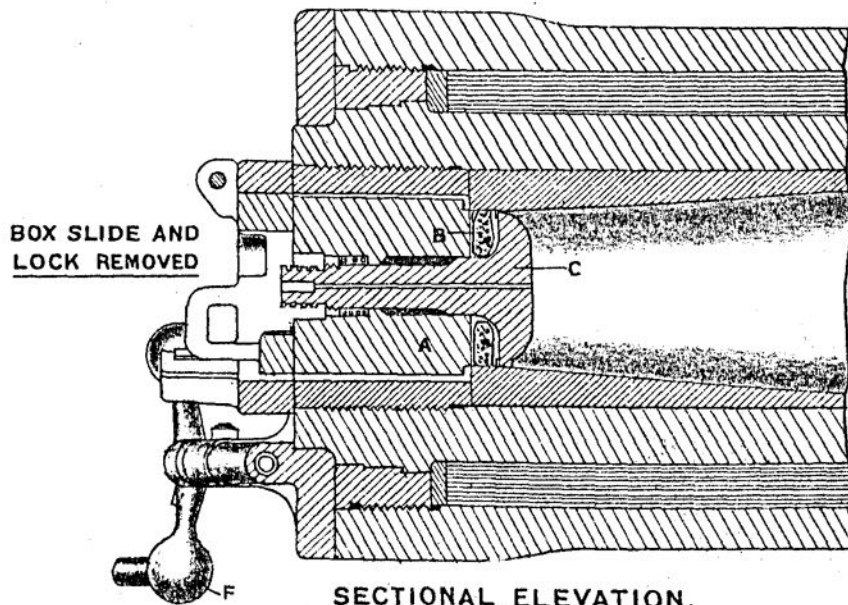
Scale $\frac{1}{40}$.



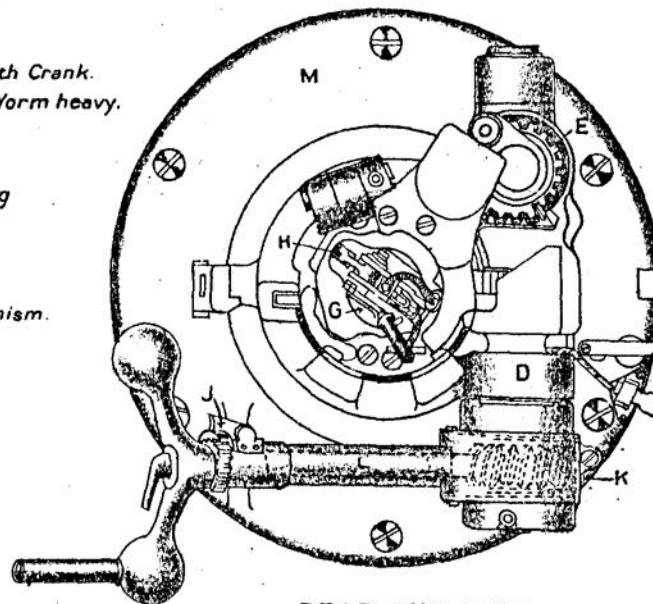
ORDNANCE, B.L. 9·2-INCH, WIRE, MARK IX.

GENERAL ARRANGEMENT BREECH MECHANISM.

SCALE = 1/2

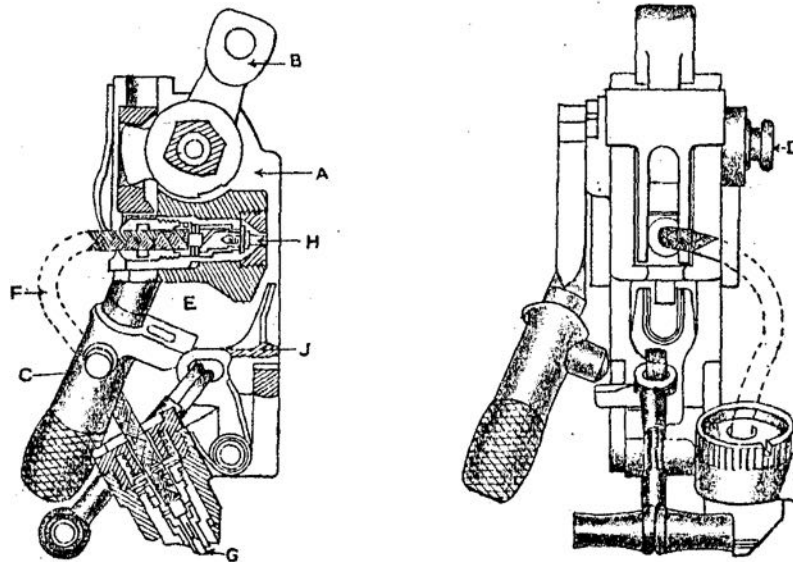


- A. Breech Screw.
- B. Pad, Obturating.
- C. Axial Vent.
- D. Carrier Ring.
- E. Bevel Wheel with Crank.
- F. Lever Spindle Worm heavy.
- G. Box, Slide.
- H. Electric Lock.
- J. Catch, retaining Carrier Ring.
- K. Worm, Wheel.
- L. " Spindle.
- M. Breech Mechanism Frame.



ORDNANCE, B.L. 9-2-INCH, WIRE, MARKS VIII & IX.
LOCK, ELECTRIC.

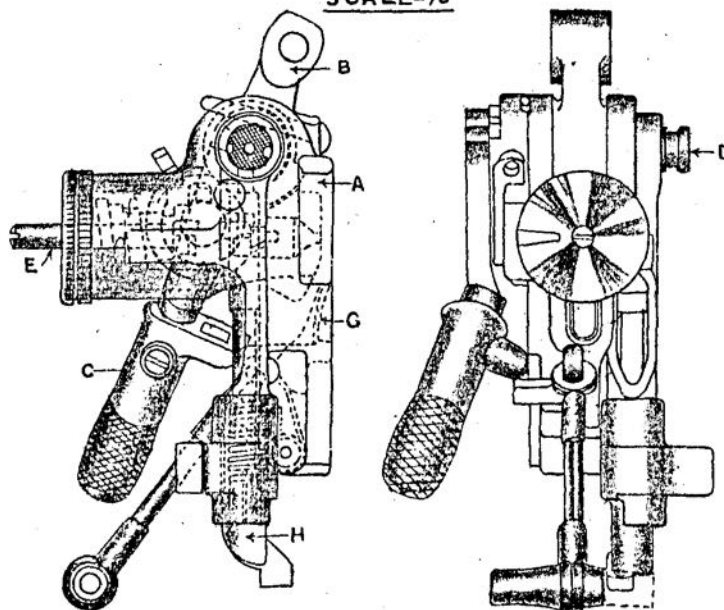
SCALE- $\frac{1}{3}$.



- | | | |
|---------------------|------------------|------------------|
| A. Lock Frame | D. Stop Catch. | G. Lower Contact |
| B. Actuating Lever. | E. Upper Contact | H. Punch. |
| C. " " Sleeve. | F. Cable | J. Extractor. |

LOCK, PERCUSSION.

SCALE- $\frac{1}{3}$

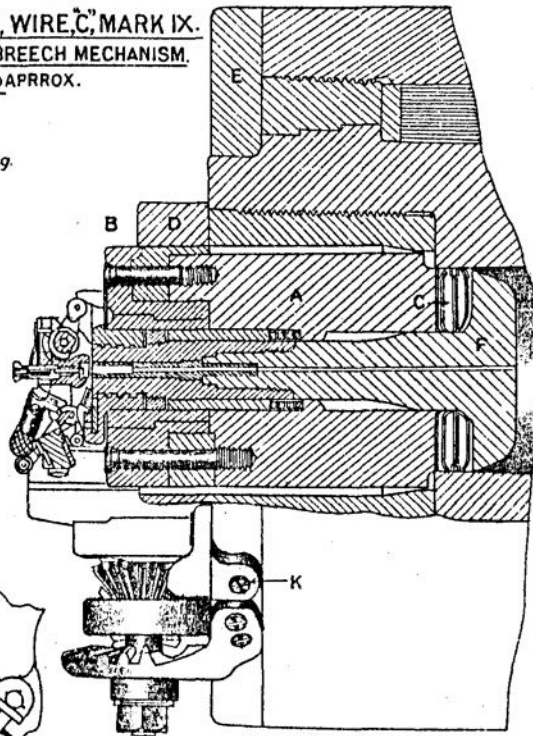


- | | | |
|---------------------|-----------------|--------------------|
| A. Lock Frame. | D. Stop. | G. Extractor. |
| B. Actuating Lever. | E. Striker. | H. Safety Plunger. |
| C. " " Sleeve. | F. Main Spring. | |

ORDNANCE, B.L. 9·2-INCH, WIRE, C, MARK IX.
GENERAL ARRANGEMENT OF BREECH MECHANISM.

SCALE $\frac{1}{10}$ APPROX.

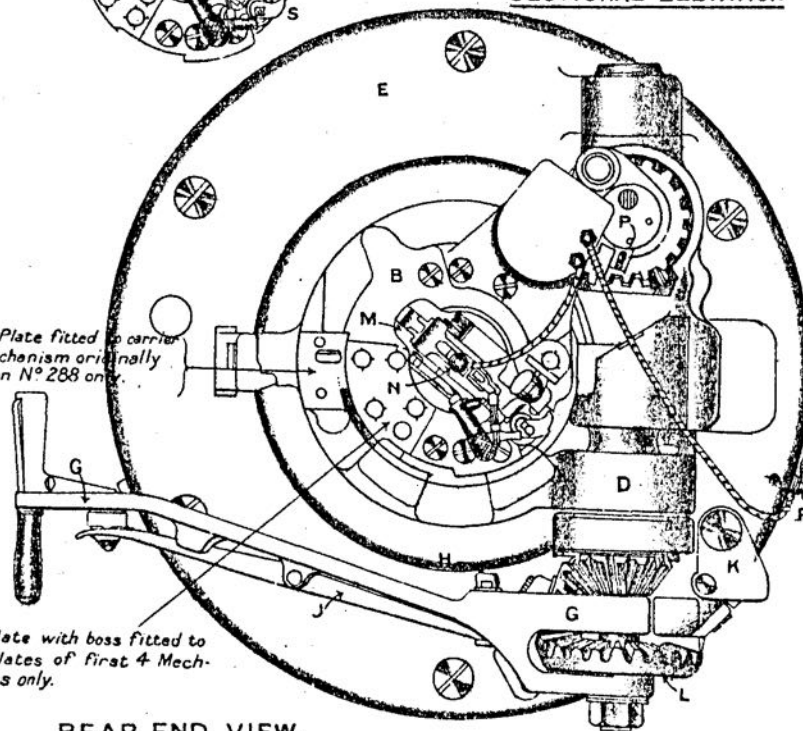
- A. Breech Screw Body.
- B. " " End Plate.
- C. Oblurating Pads with Centre Ring.
- D. Carrier Ring.
- E. Breech Mechanism Frame
- F. Axial Vent.
- G. Breech Mechanism Lever.
- H. Catch, retaining Carrier Ring.
- J. Lever, Actuating Catch.
- K. Bracket, Catch retaining Carrier Ring.
- L. Bracket toothed segment
- M. Box, Slide.
- N. Electric Lock.
- O. Percussion Lock.
- P. Contact Electric safety firing.
- R. Terminal.
- S. Safety Lever.



SECTIONAL ELEVATION

Cover Plate fitted to carrier of Mechanism originally on Gun N° 288 only.

Key Plate with boss fitted to end Plates of first 4 Mechanisms only.

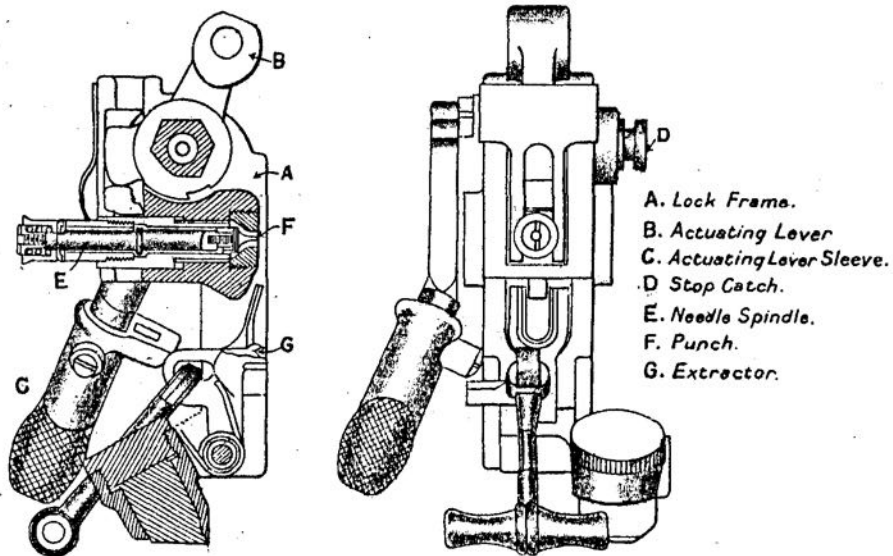


REAR END VIEW.

ORDNANCE, B.L. 9.2-INCH, WIRE, "C" MARK IX.

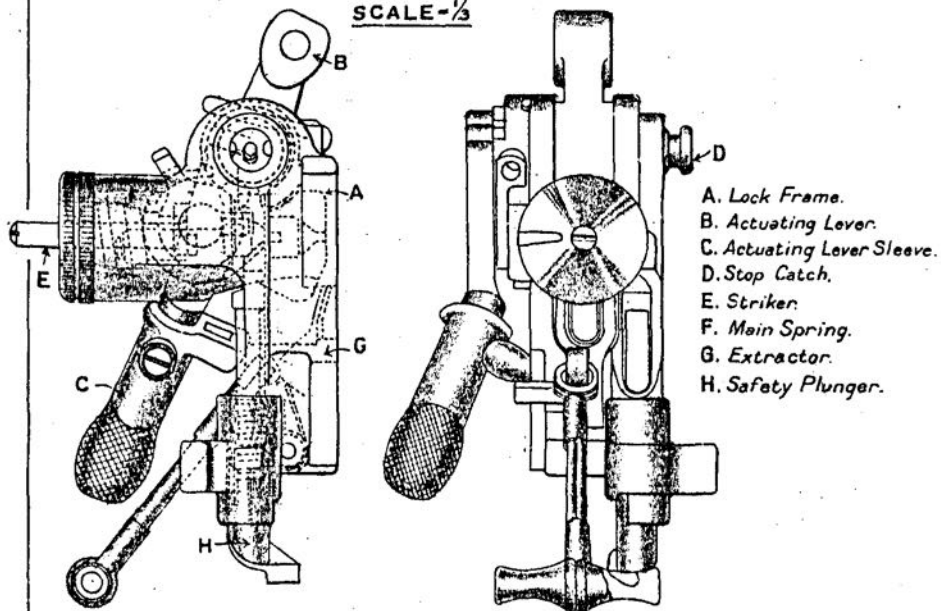
LOCK, ELECTRIC.

SCALE = $\frac{1}{3}$



LOCK, PERCUSSION.

SCALE = $\frac{1}{3}$

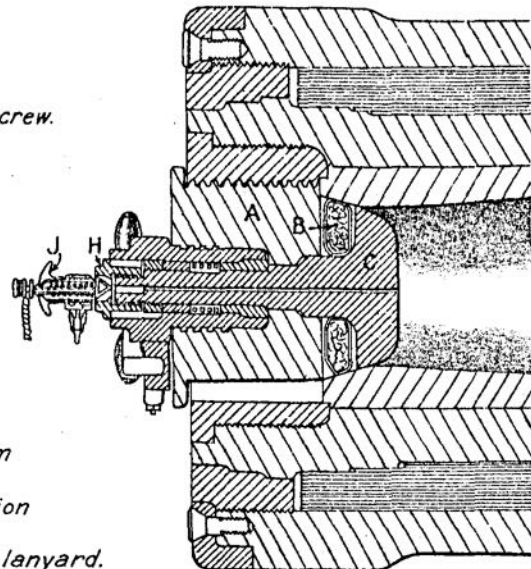


ORDNANCE, B.L. 9·2^{IN}, WIRE, MARKS X, X^V & X*.

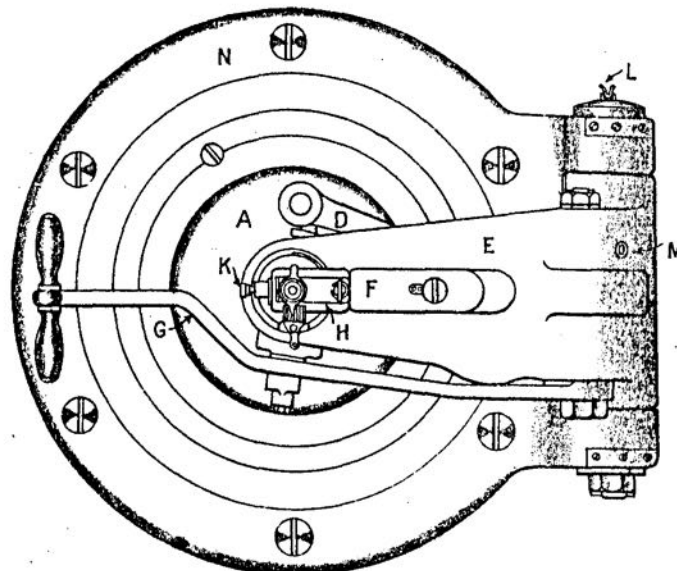
GENERAL ARRANGEMENT OF BREECH MECHANISM.

SCALE - $\frac{1}{12}$

- A. Breech Screw.
- B. Obturator.
- C. Axial Vent.
- D. Link, actuating Breech Screw.
- E. Carrier
- F. Link, actuating Lock.

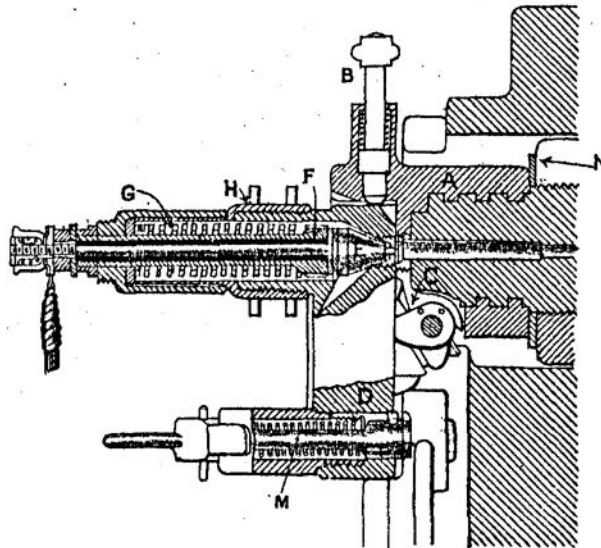


- G. Lever, Breech Mechanism
- H. Box, Slide.
- J. Lock, Electric & Percussion
- K. Tube retainer.
- L. Clip, supporting cocking lanyard.
- M. Hook, supporting cable.
- N. Breech mechanism frame.

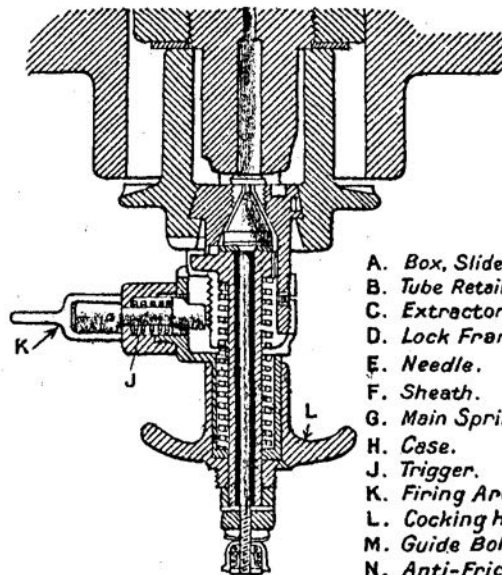


ORDNANCE, B.L. LOCK, ELECTRIC & PERCUSSION, "E",
M^K II. BOX, SLIDE, "A".

SCALE = 1/3.



SECTIONAL ELEVATION.



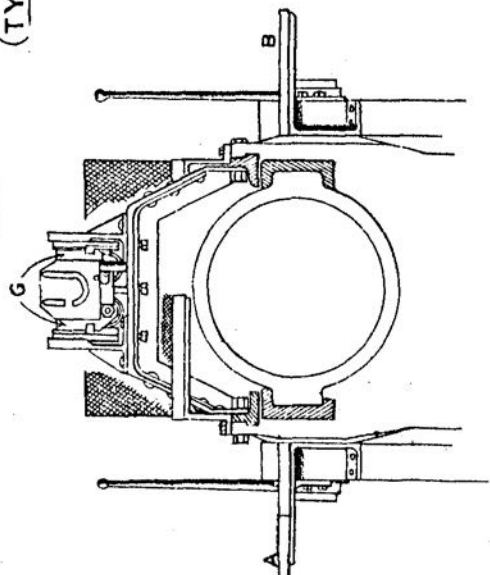
- A. Box, Slide.
- B. Tube Retainer.
- C. Extractor.
- D. Lock Frame.
- E. Needle.
- F. Sheath.
- G. Main Spring.
- H. Case.
- J. Trigger.
- K. Firing Arc.
- L. Cocking Handle.
- M. Guide Bolt.
- N. Anti-Friction Washer.

SECTIONAL PLAN.

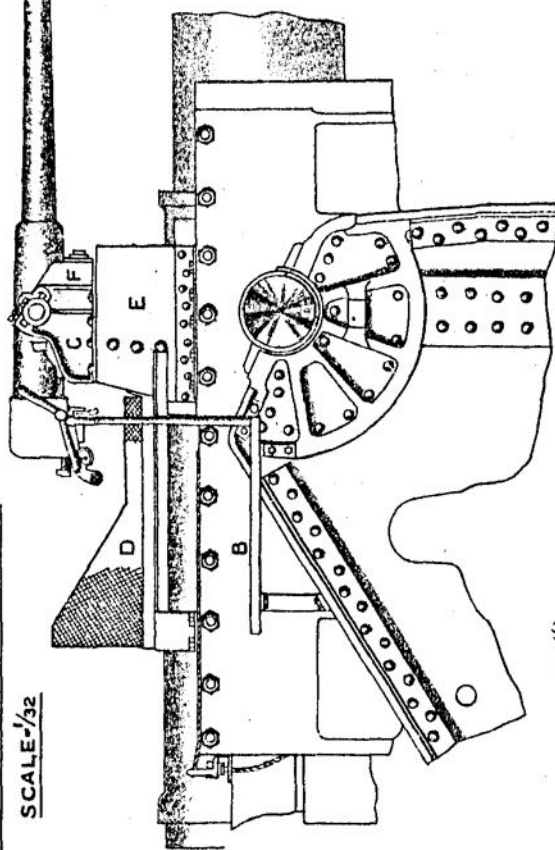
CARRIAGE, Q. F. 6-P. HOTCHKISS SUB CALIBRE GUN,
MARK V, VI, VI^A BARBETTE B. L. 9.2 INCH. MARK I.

(TYPICAL FOR MKS. V^A AND V^B)

SCALE = 1/32



REAR ELEVATION.

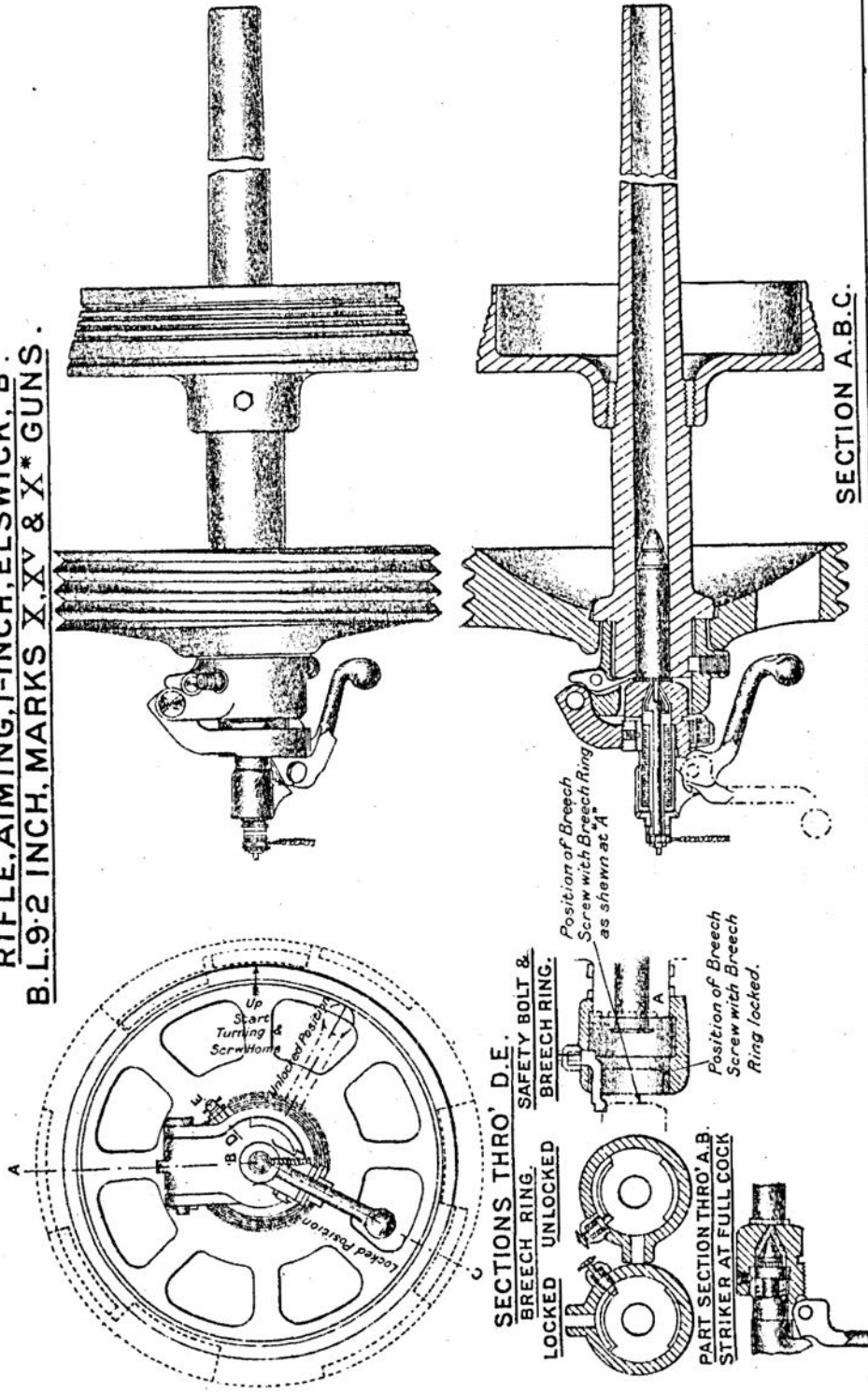


SIDE ELEVATION.

- A } Platform. Loading { Left (L)
- B } { Right (R)
- C. Brackets, Cradle Trunnions
- D. Catcher, Cartridge Cases.
- E. Saddle (S)
- F. Cradle.
- G. Crosshead.

(S) Design varies for VI, VI^A see page. 27.

**RIFLE, AIMING, 1-INCH, ELSWICK, "B".
B.L. 9-2 INCH, MARKS X, XV & X* GUNS.**



SECTION A.B.C.

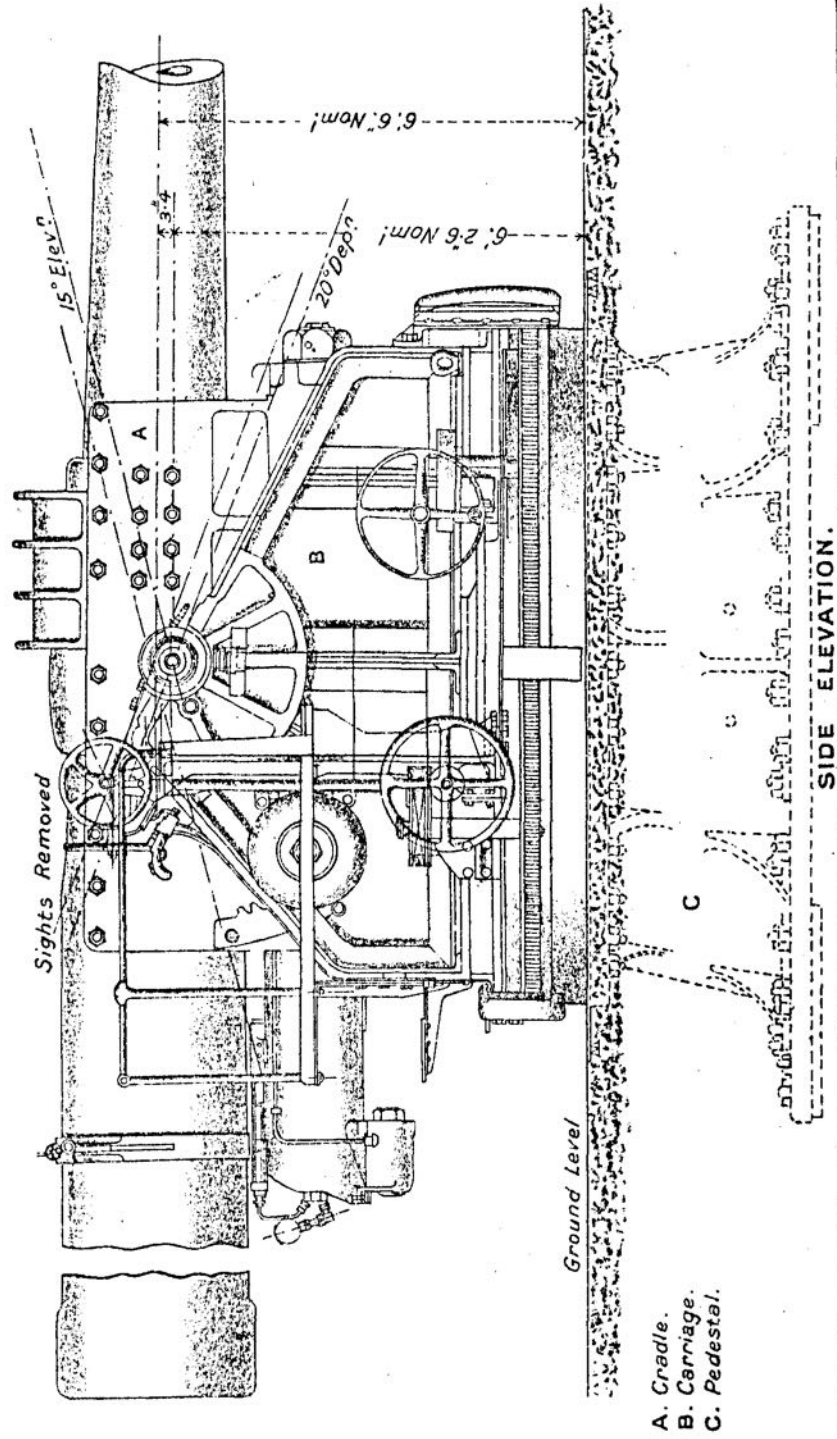
**SECTIONS THRO' D.E.
SAFETY BOLT &
BREECH RING.**

LOCKED UNLOCKED

**PART SECTION THRO' A.B.
STRIKER AT FULL COCK**

CARRIAGE, GARRISON BARBETTE, B.L. 9-2-INCH, MARK IV.

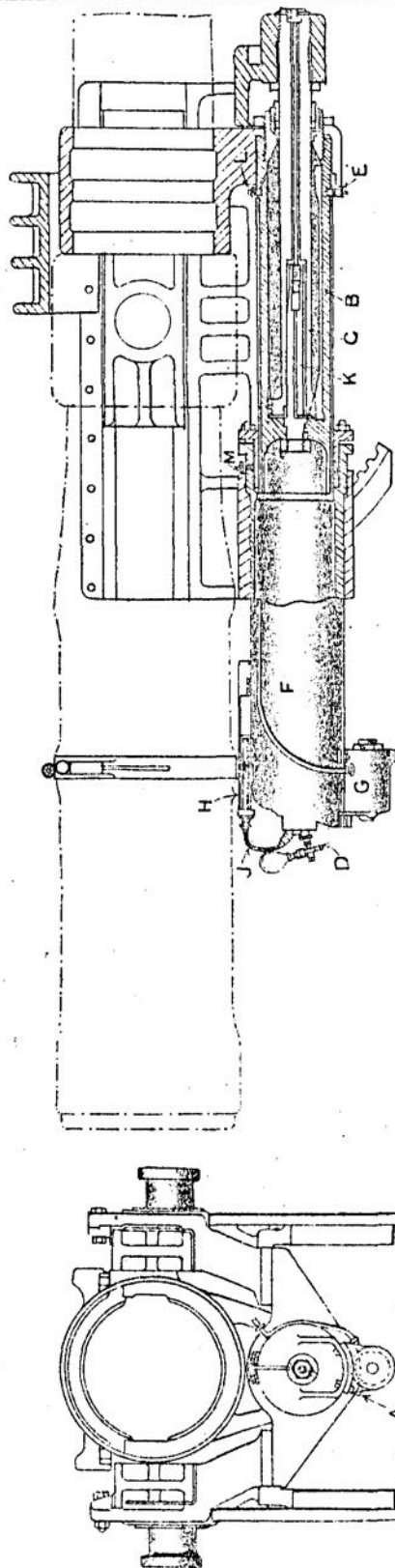
Inches 12 9 6 3 0 1 2 3 4 5 6 7 Feet
SCALE.



CARRIAGE. GARRISON, BARBETTE, B. L. 9.2-INCH, MARK IV.

GENERAL ARRANGEMENT OF CRADLE, WITH AIR CYLINDER AND HYDRAULIC BUFFER.

SCALE $\frac{1}{32}$.



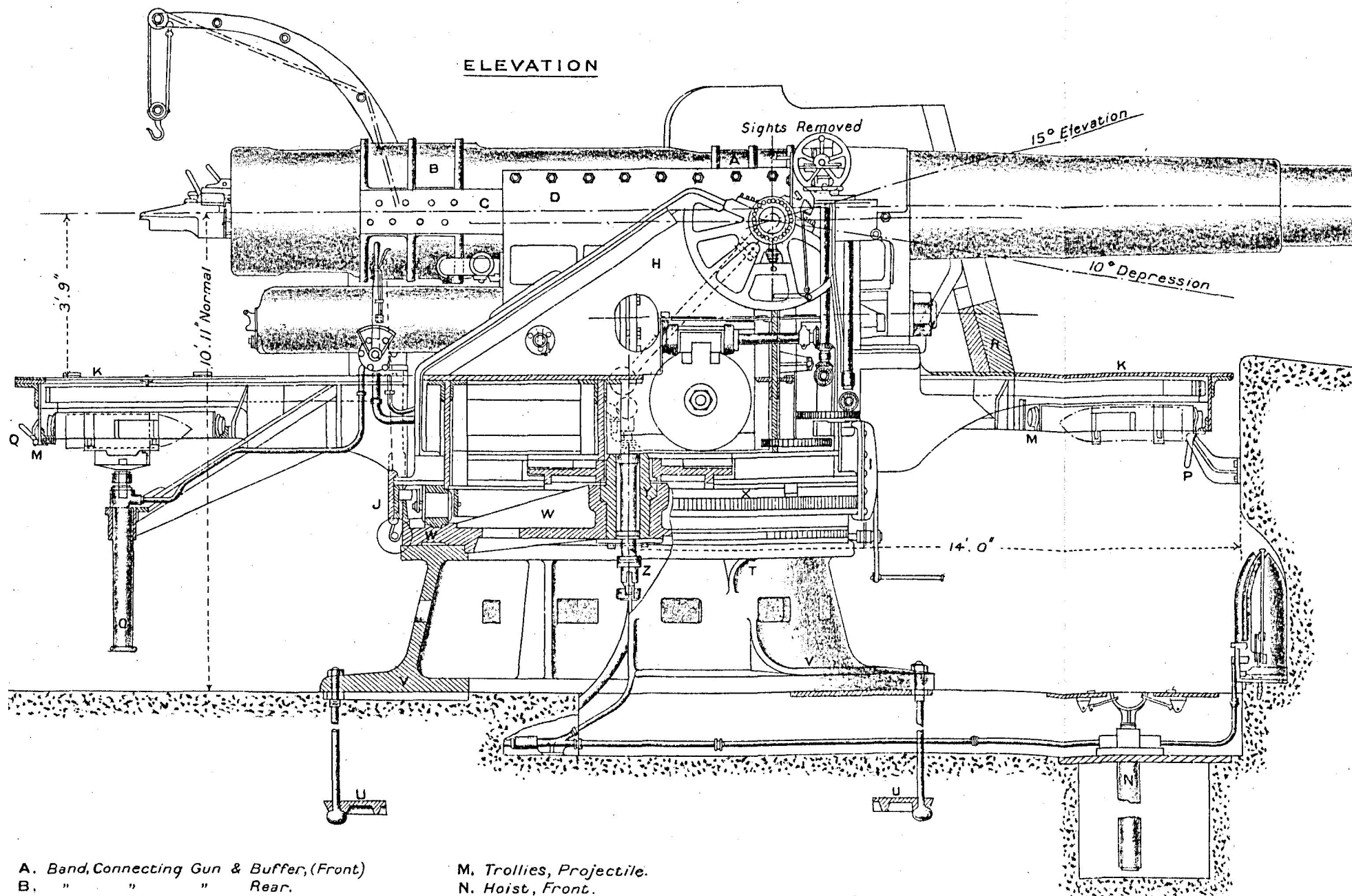
REAR END VIEW

SECTIONAL ELEVATION.

- | | |
|--------------------------------|----------------------------|
| A. Valve, Filling Intensifier. | G. Intensifier. |
| B. Buffer Cylinder. | H. Air Pump. |
| C. Piston, with Rod | J. Pipe, connecting Pump. |
| D. Valve. | K. Controlling Plunger. |
| E. " Filling & emptying. | L. Plug, Air (Buffer Cyl.) |
| F. Air Cylinder. | M. " " (Air ") |

CARRIAGE, GARRISON, BARBETTE, B.L. 9·2-INCH, MARK V.

SCALE = 1/36.

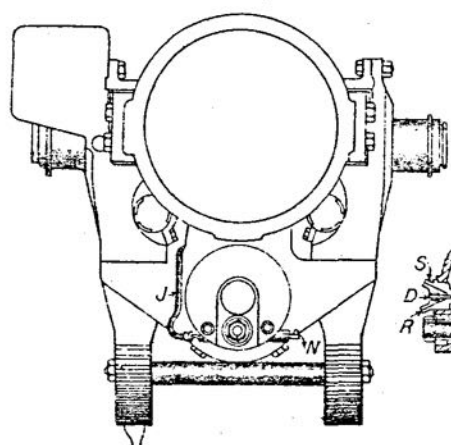


- A. Band, Connecting Gun & Buffer, (Front)
- B. " " " " Rear.
- C. Bars, Sliding Gun.
- D. Cradle.
- H. Carriage.
- I. Plate, Clip, Front
- J. " " " " Rear.
- K. Shield, Shell Pit

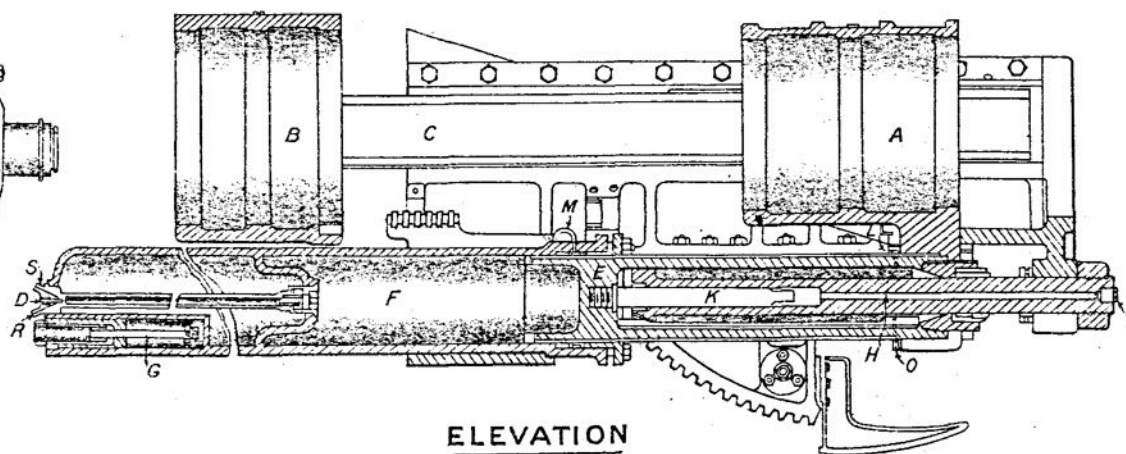
- M. Trollies, Projectile.
- N. Hoist, Front.
- O. " " " " Rear.
- P. Bracket, Catch retaining Trolley, Front.
- Q. Catch, retaining Trolley, Rear.
- R. Shield, Front.
- T. Arc, Traversing
- U. Holdfast. Carriage. Pedestal.

- V. Pedestal.
- W. Plate, Pivot.
- X. Rack, Traversing.
- Y. Plug, Pivot.

CARRIAGE, GARRISON, BARBETTE, B.L. 9·2 INCH, MARK V.
GENERAL ARRANGEMENT OF CRADLE WITH AIR CYLINDER AND HYDRAULIC BUFFER.
SCALE = 1/32.



REAR VIEW.

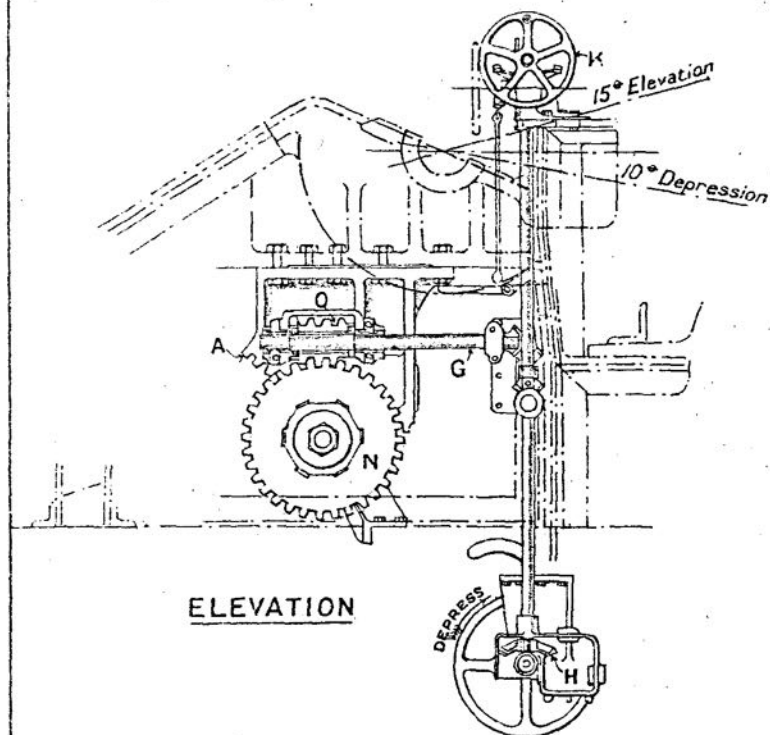


ELEVATION

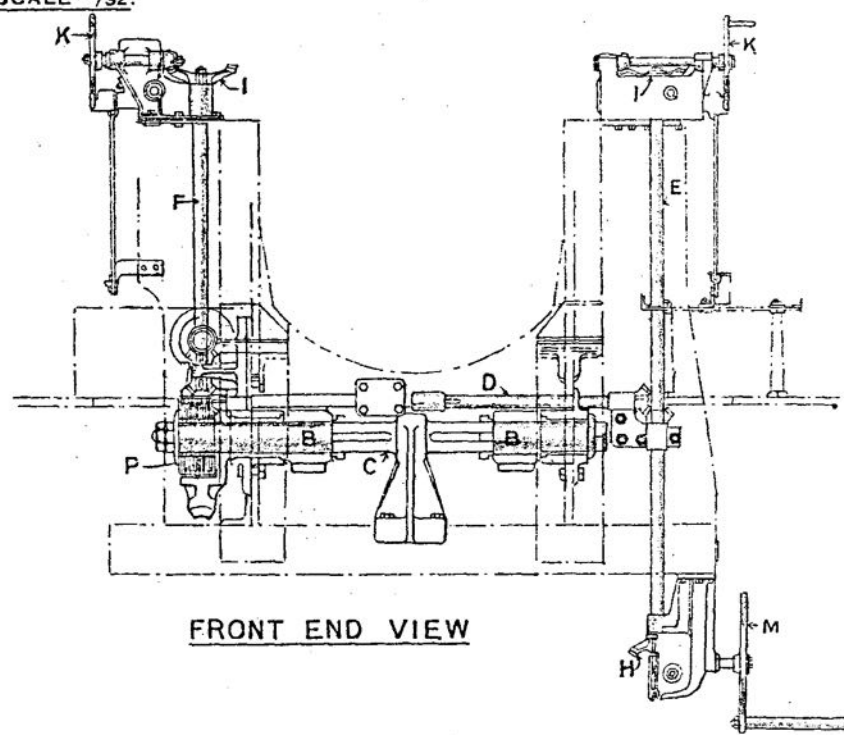
- | | | |
|---|----------------------------------|--|
| A. Band, connecting gun & buffer | G. Intensifier. | N. Valve, filling & emptying (intensifier) |
| B. " gun, rear. | H. Piston, with rod. | O. " " " (buffer cyl.) |
| C. Bars, sliding gun. | J. Pipe, connecting intensifier. | R. Nozzle for pressure gauge. |
| D. Plug, outer, air cylinder, with valve and gland. | K. Controlling Plunger. | S. " " connecting air pump. |
| E. Buffer cylinder. | L. Plug, Air (buffer cyl.) | T. Plug piston rod. |
| F. Air cylinder. | M. " " (Air ") | |

CARRIAGE, GARRISON, BARBETTE. B.L. 9·2-INCH MARK V.
GENERAL ARRANGEMENT OF ELEVATING GEAR.

SCALE - $\frac{1}{32}$.



ELEVATION



FRONT END VIEW

A. Arcs.
 B. Pinions, Arc.
 C. Shaft, Arc Pinions.
 D. " Cross.

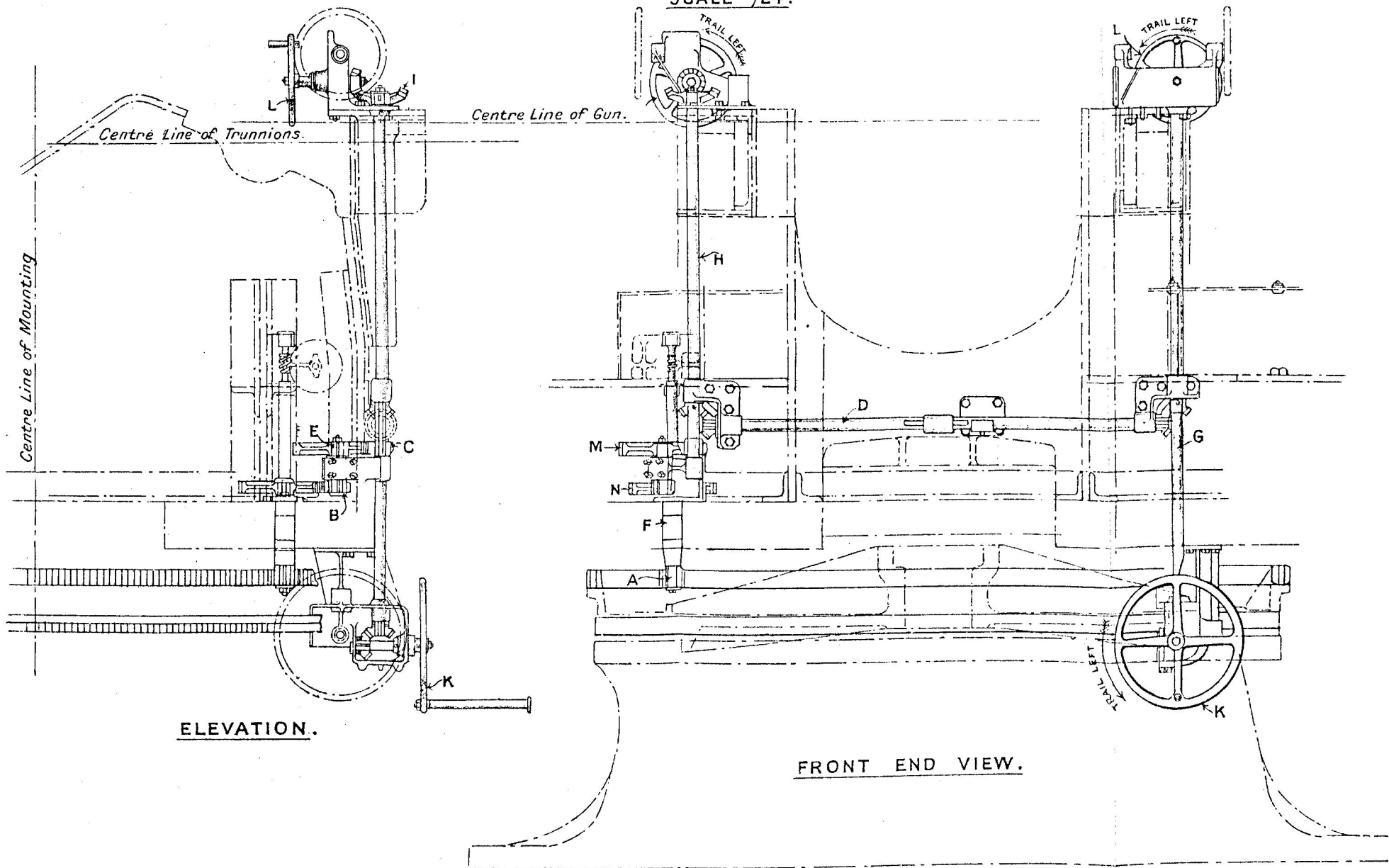
E. Shafts, Vertical { Left
 F. " " { Right
 G. Shaft, Worm.
 H. Wheel, Bevel, Vertical Shafts, Lower.

I. Wheel, Bevel, Vertical Shafts, Upper.
 K. Wheel, Hand, 16 Inch.
 M. " " 24 "
 N. " Worm

O. Worm.
 P. Rings, Friction.

SALVAGE, SALVATION, SAVANNAH, SAVE -

SCALE 1/24.



- A. *Pinion Rack.*
- B. „ *Spur Intermediate Shaft*
- C. „ „ *Vertical „*
- D. *Shaft, Cross.*

- E. *Shaft, Intermediate.*
- F. *" Rack Pinion.*
- G. *" Vertical Left*
- H. *" " Right*
- I. *Wheel, Bevel, Vertical Shaft*

- K. *Wheel, Hand 24 Inch (with folding handle)*
 L. " " 16 " (" " ")
 M. " *Spur, Intermediate Shaft.*
 N. " " *Rack Pinion.* "

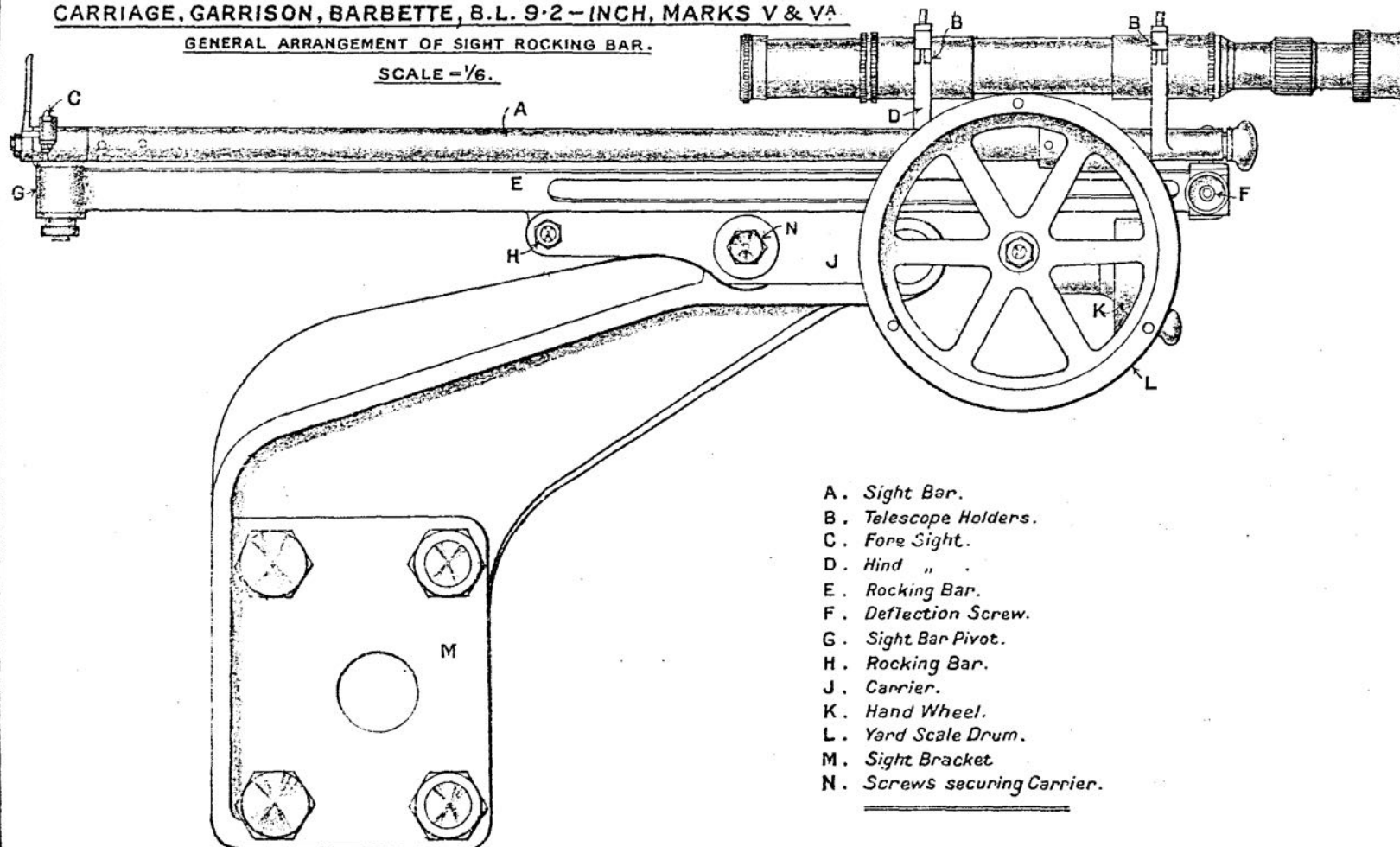
[illegible]

- A. Cam.
- B. Yard Scale Plate.
- C. Pointer.
- D. Cam Lever.
- E. M.V. Scale.
- F. Charge Temperature Scale.
- G. Actuating Link.

CARRIAGE, GARRISON, BARBETTE, B.L. 9-2-INCH, MARKS V & VA

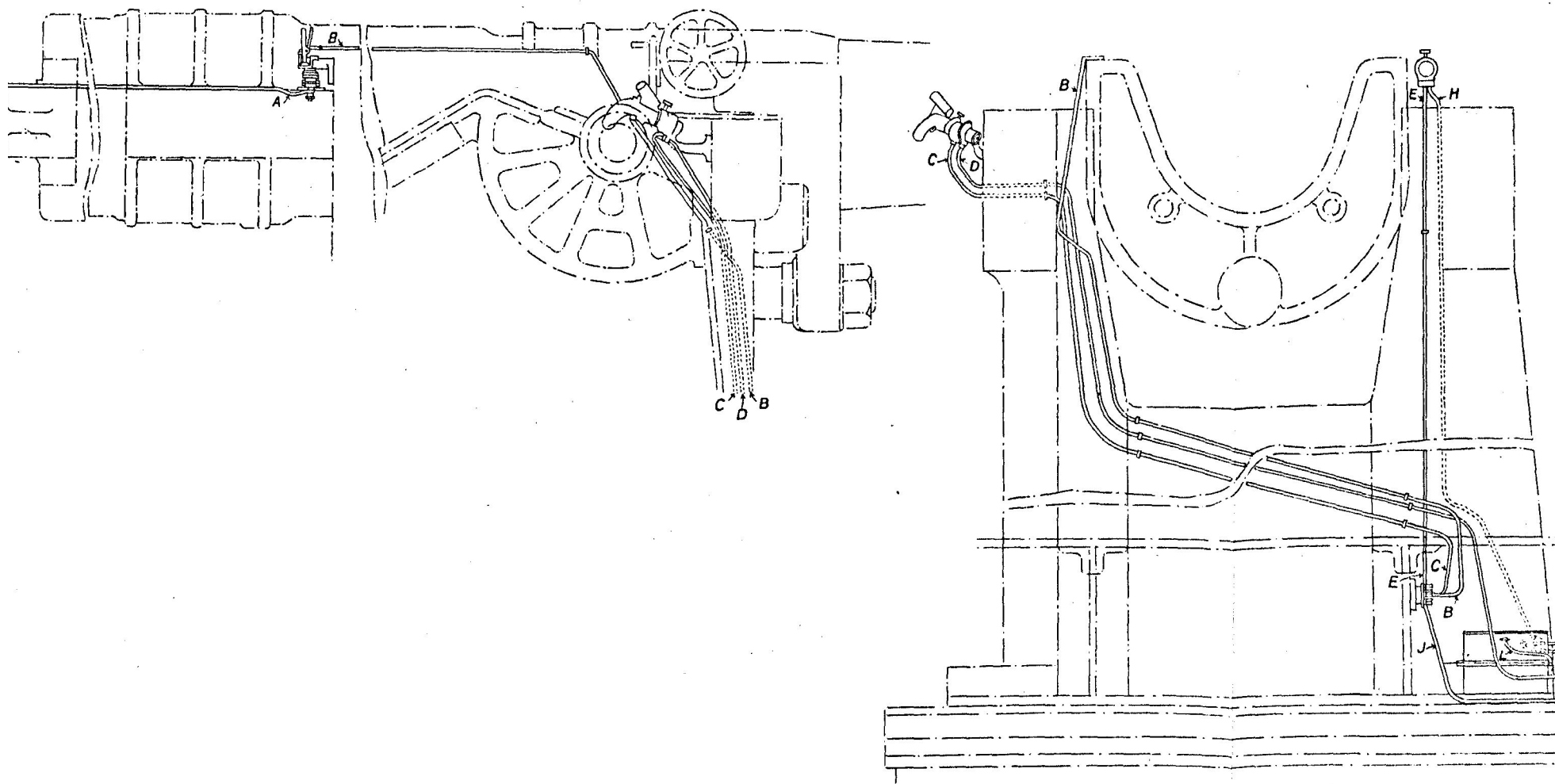
GENERAL ARRANGEMENT OF SIGHT ROCKING BAR.

SCALE = 1/6.



- A. Sight Bar.
- B. Telescope Holders.
- C. Fore Sight.
- D. Hind " .
- E. Rocking Bar.
- F. Deflection Screw.
- G. Sight Bar Pivot.
- H. Rocking Bar.
- J. Carrier.
- K. Hand Wheel.
- L. Yard Scale Drum.
- M. Sight Bracket.
- N. Screws securing Carrier.

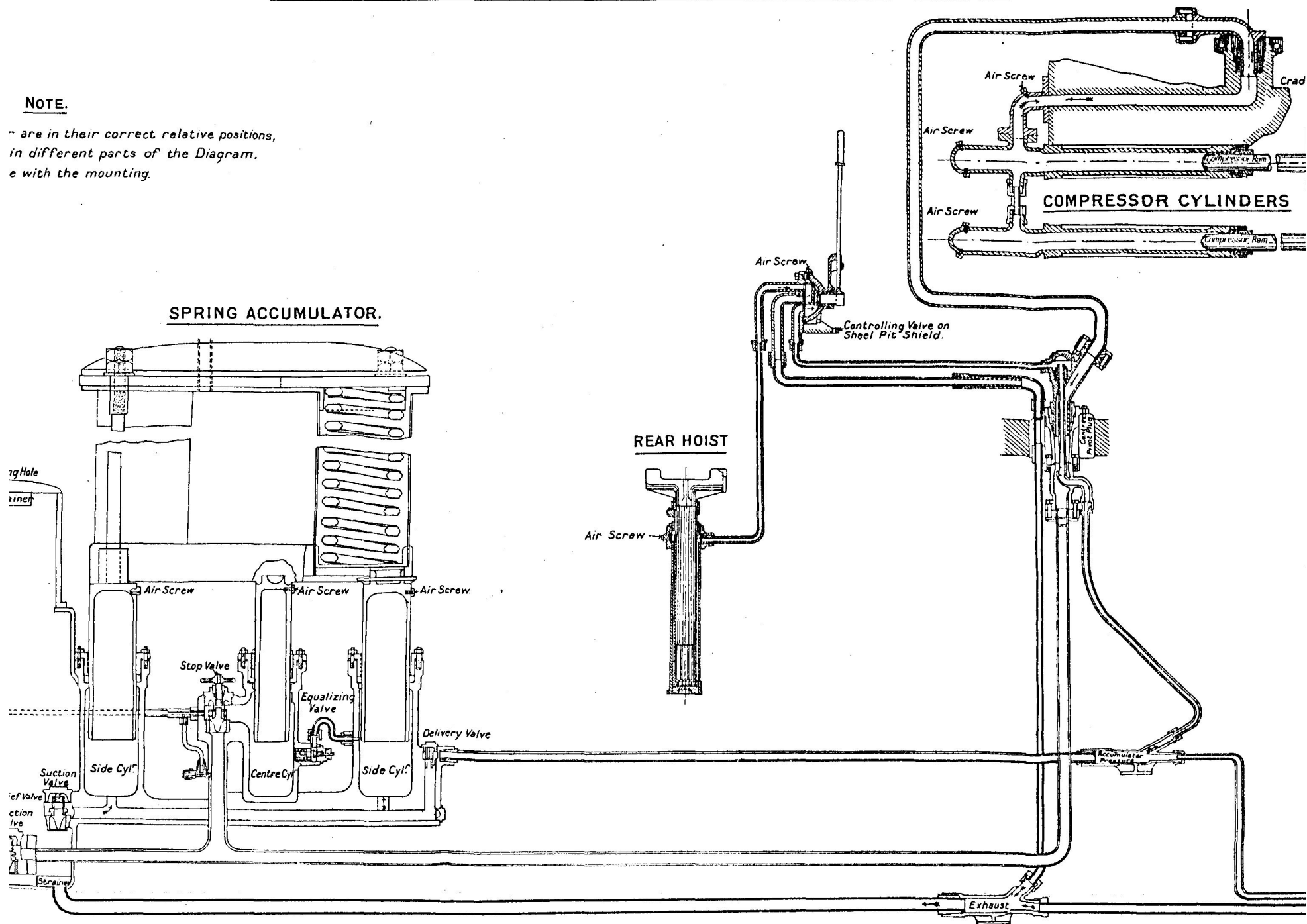
GEAR, ELECTRIC, FIRING.
TYPICAL.



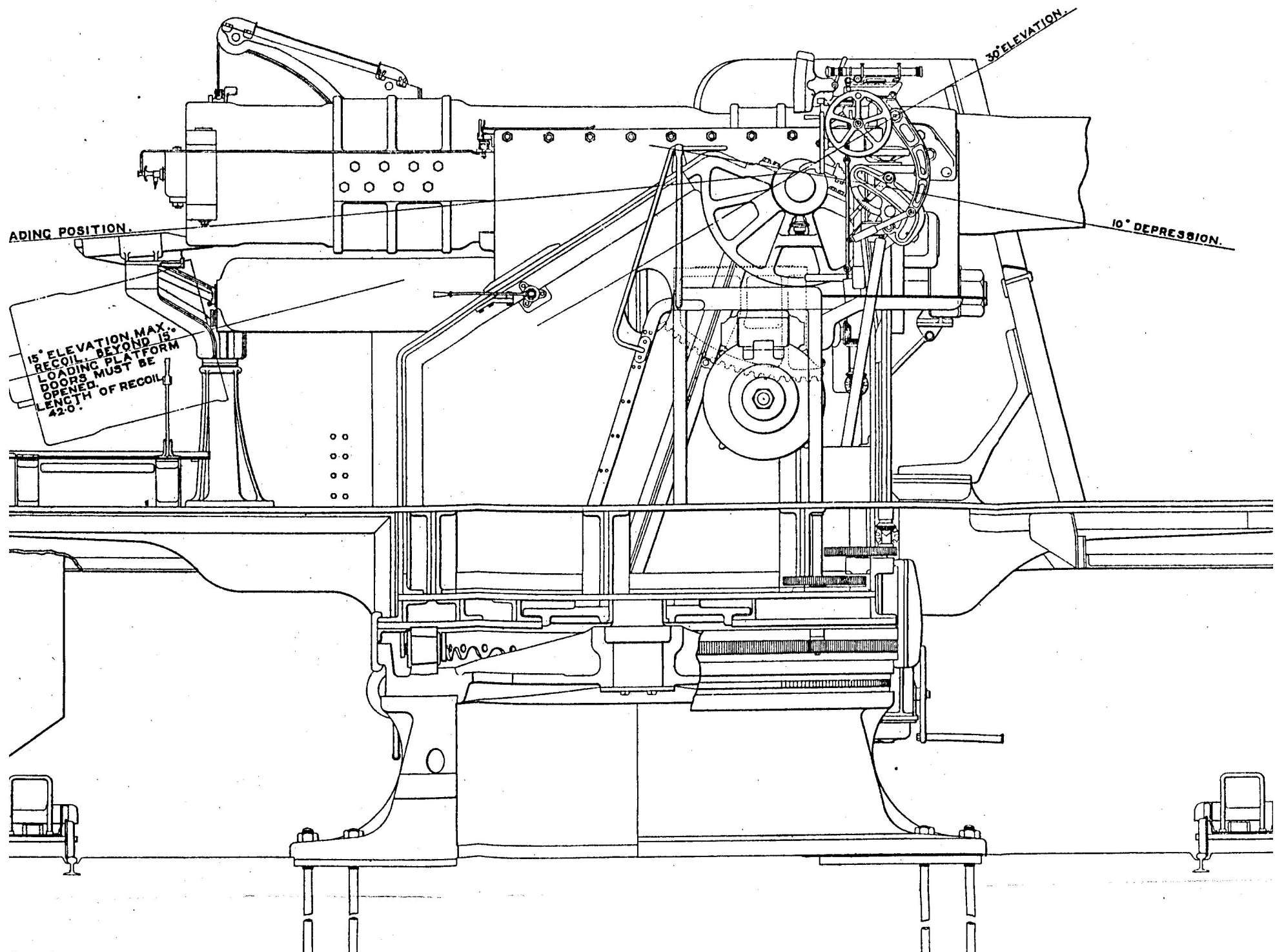
**DIAGRAMMATIC DRAWING SHOWING THE HYDRAULIC LOADING GEAR OF CARRIAGES.
GARRISON, BARBETTE, B.L., 9-2-INCH, MARK V, MARKS V^A AND V^B**

NOTE.

are in their correct relative positions,
in different parts of the Diagram.
e with the mounting.



SCALE = 1/30 APPROX.

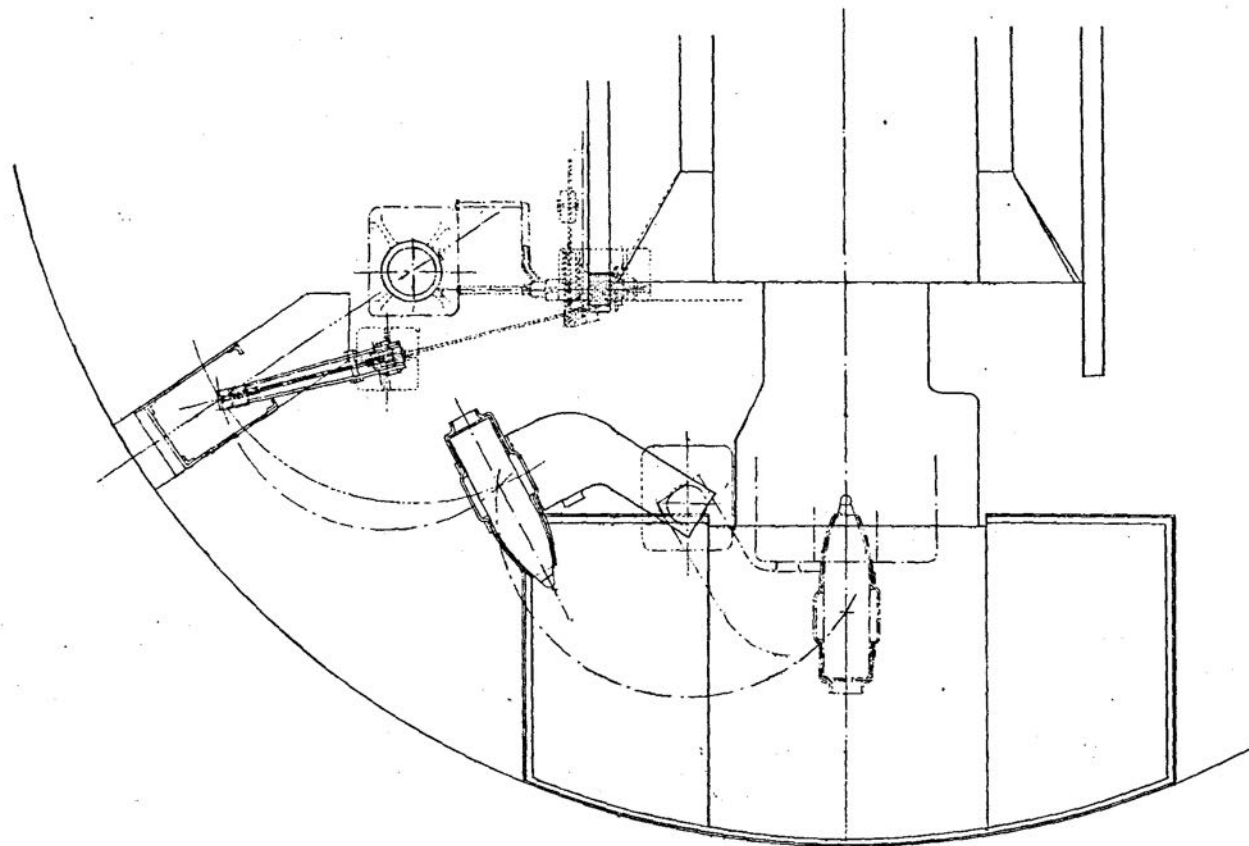


CARRIAGE, GARRISON, BARBETTE, B.L. 9·2-INCH, MARKS VI & V^A

REMOVABLE AUXILIARY LOADING DERRICK.

SCALE $\frac{1}{32}$ APPROX.

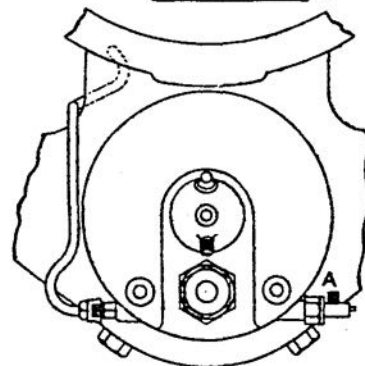
PLAN



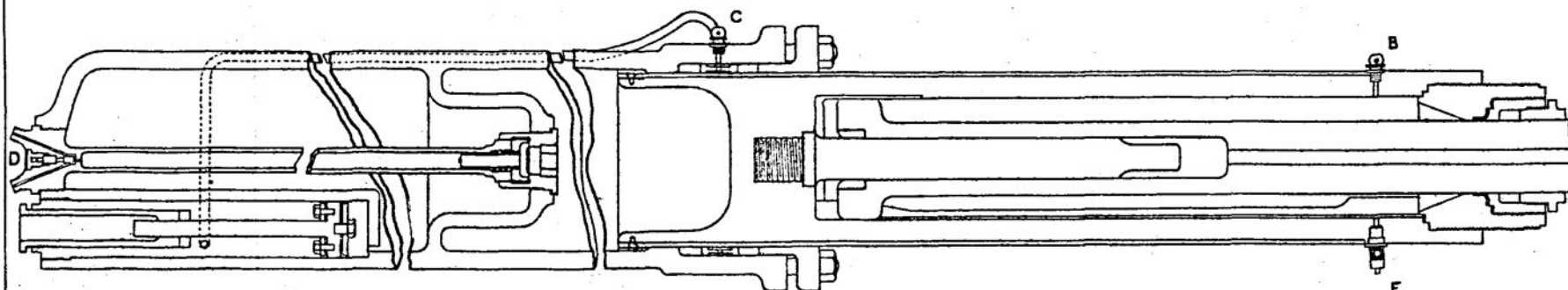
CARRIAGE, CARRISON, BARBETTE, B.L. 9.2-INCH, MARKS VI & VI A.

General Arrangement of Buffer, Air Cylinder and Intensifier.

Scale = 1/4 approx.



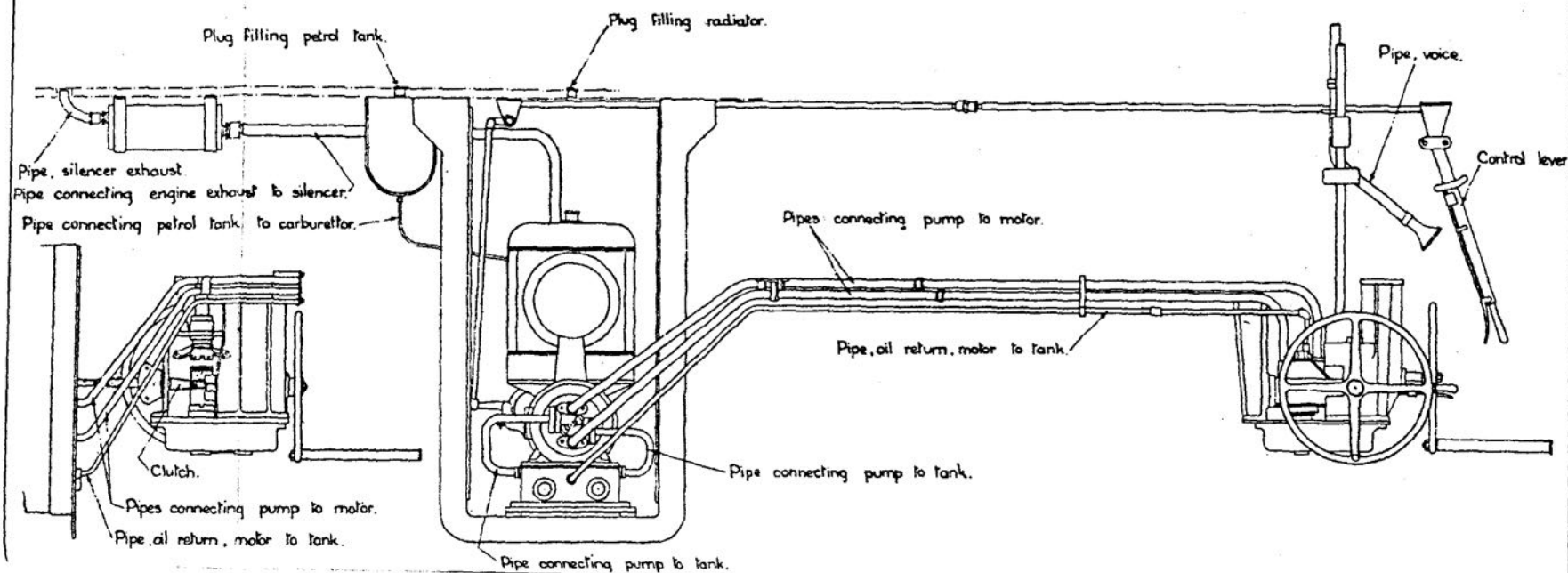
Rear View.



CARRIAGE, GARRISON, BARBETTE, B.L. 9.2-INCH, MARKS VI & VI^A

ARRANGEMENT OF MOTOR, PUMP, PIPES AND CONNECTIONS OF ELEVATING GEAR.

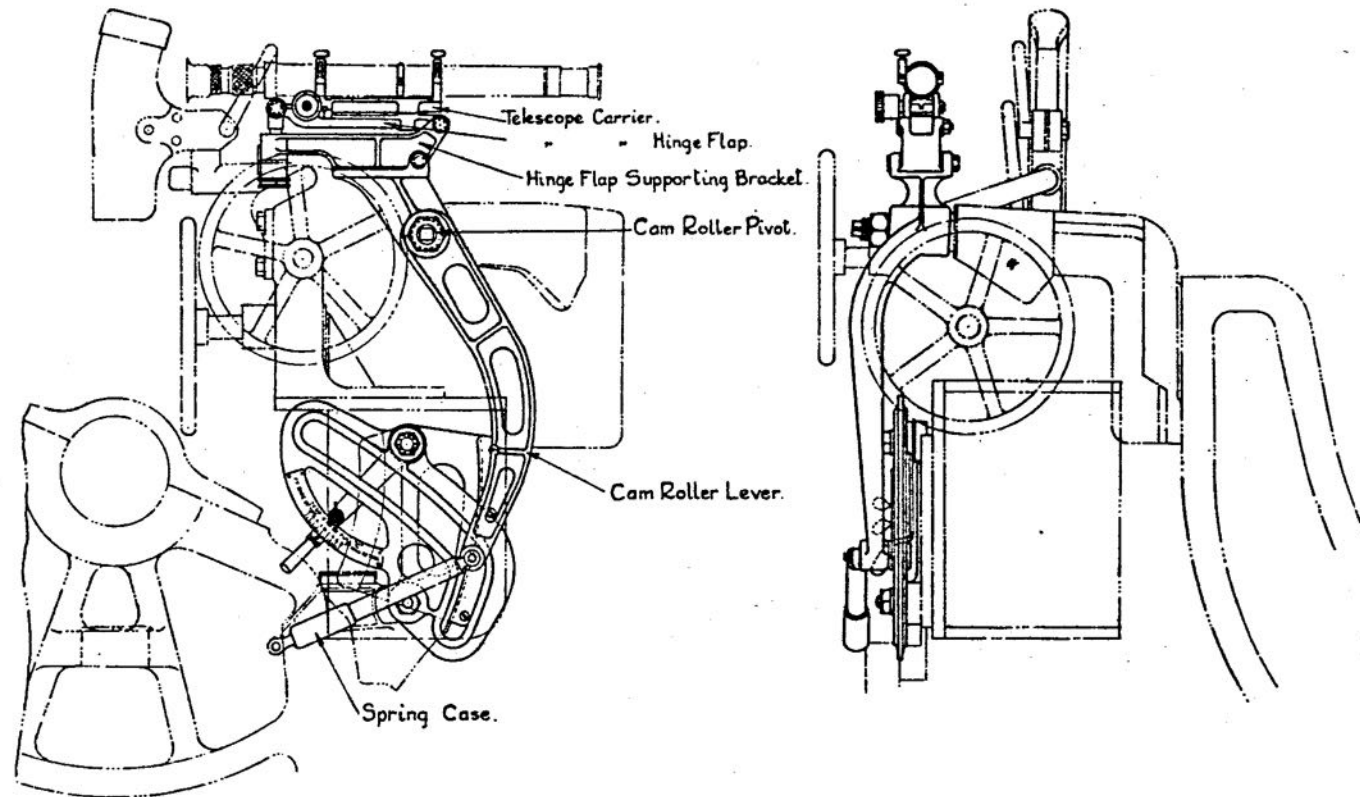
Scale = 1/26 approx.



SIGHT, AUTOMATIC, MARKS VI & VI^A CARRIAGES.

GENERAL ARRANGEMENT.

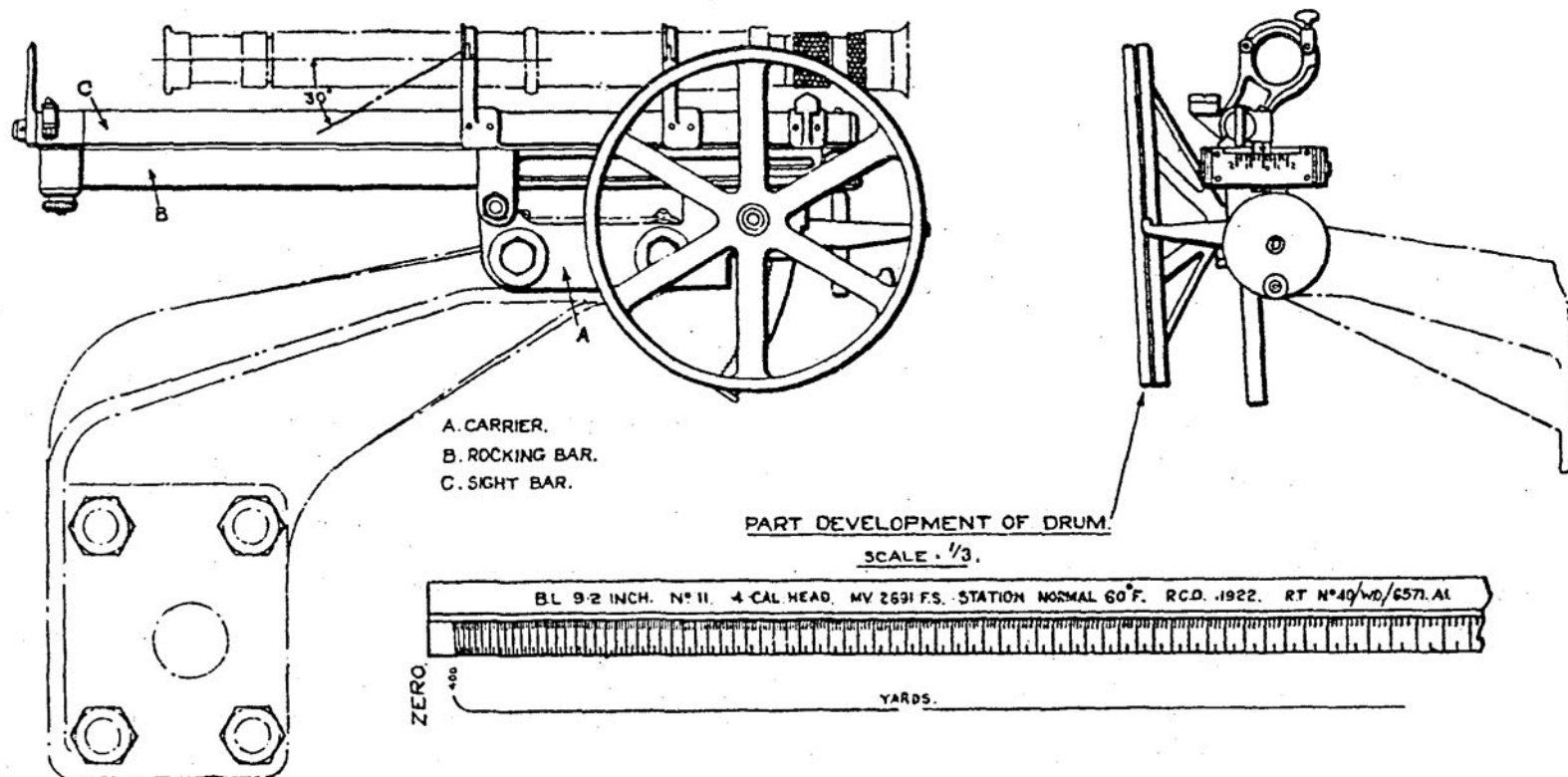
Scale = 1/16.



SIGHT, ROCKING BAR, M^{KS} VI & VI^A, CARRIAGES.

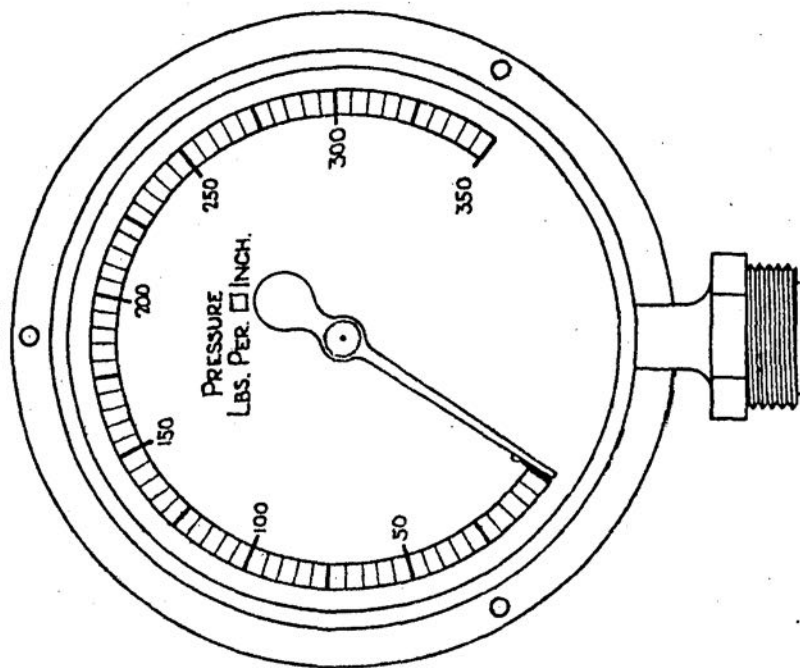
GENERAL ARRANGEMENT.

SCALE = 1/8.

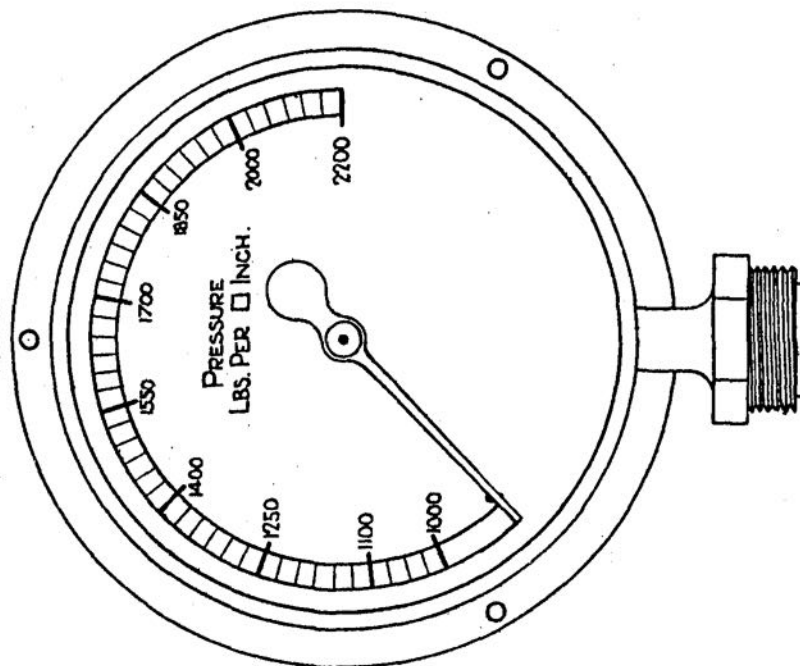


GAUGES, PRESSURE.

Nº 1.

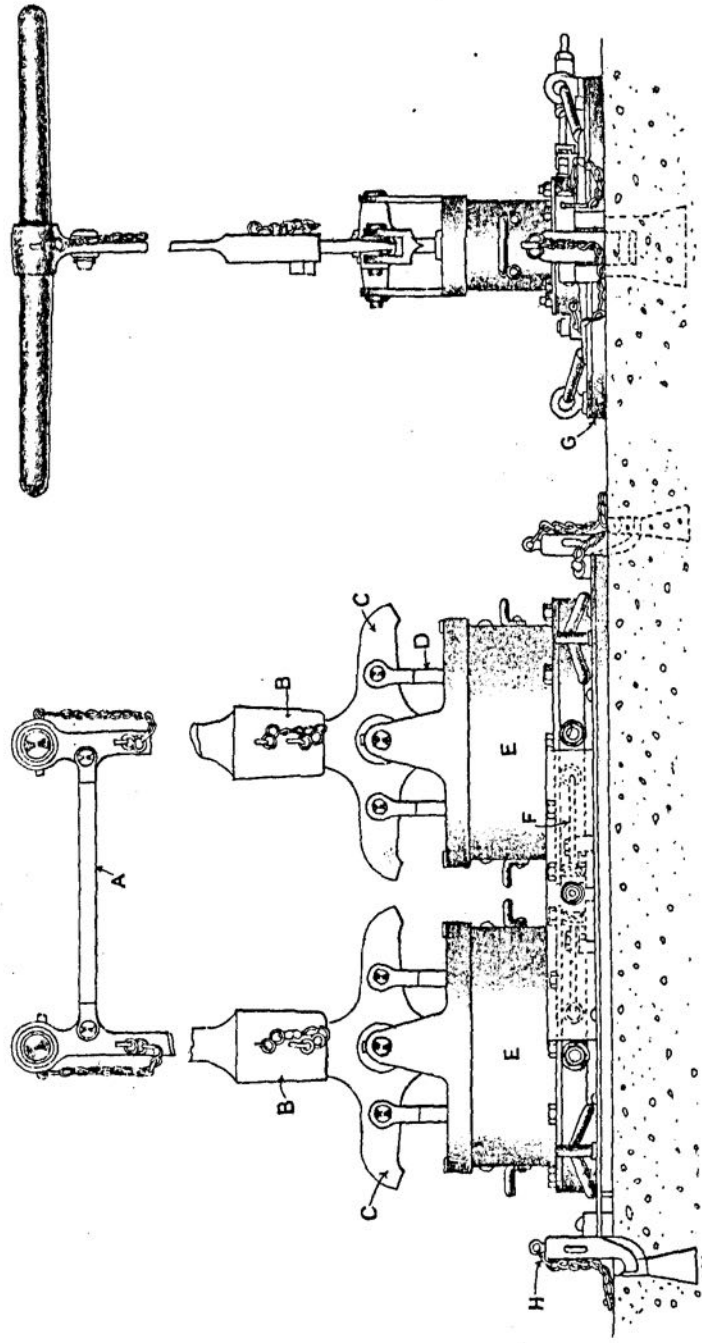


Nº 3.



PUMP, AIR, DOUBLE, MARK I.

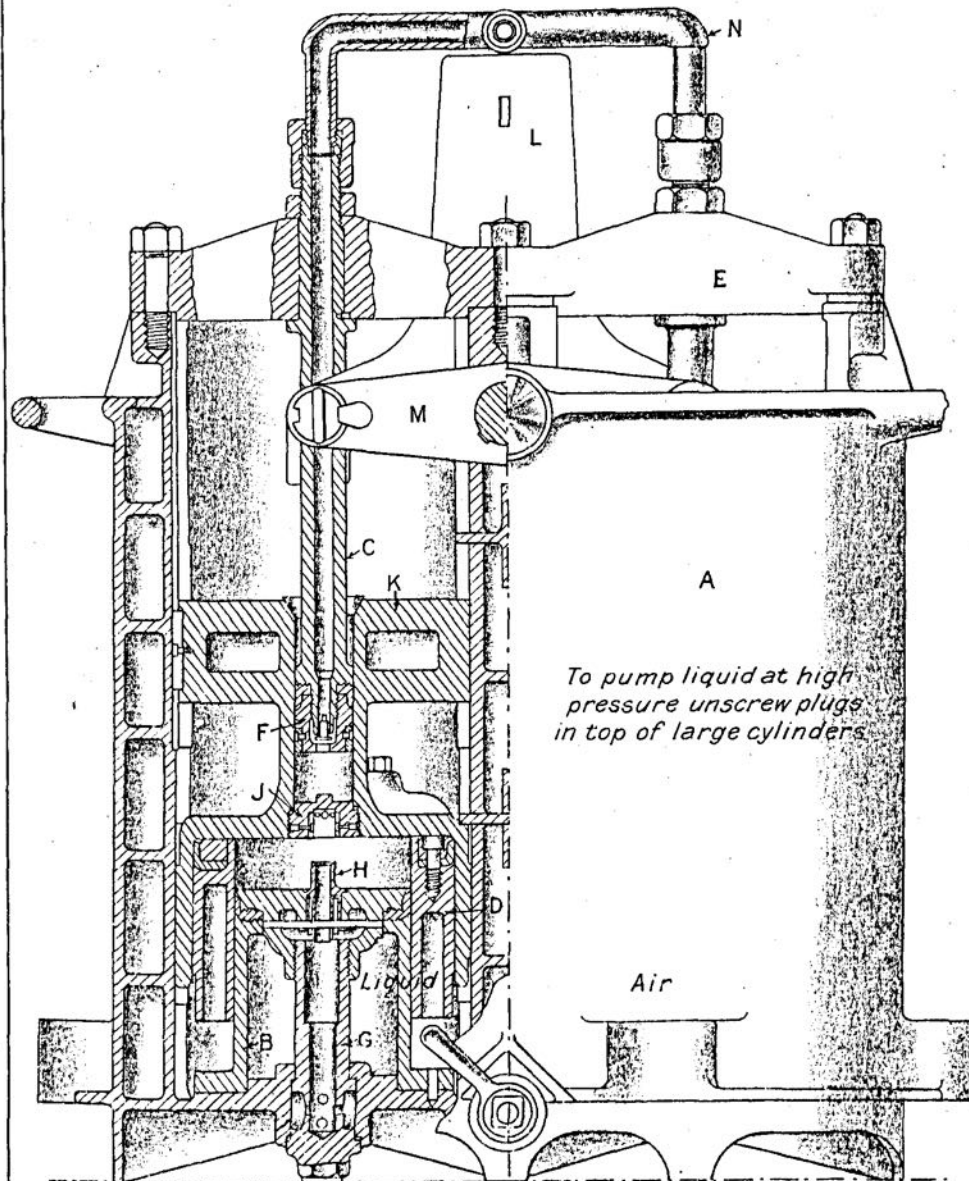
SCALE $\frac{1}{16}$.



- A. Rod connecting Socket Levers
- B. Lever Socket.
- C. " " Rocking
- D. Plungers (Large & Small)
- E. Tanks.
- F. Pipes Delivery.
- G. Plate Base.
- H. " " Clip.

PUMP, AIR OR LIQUID, MARK II.

SCALE - 1/8 APPROX.

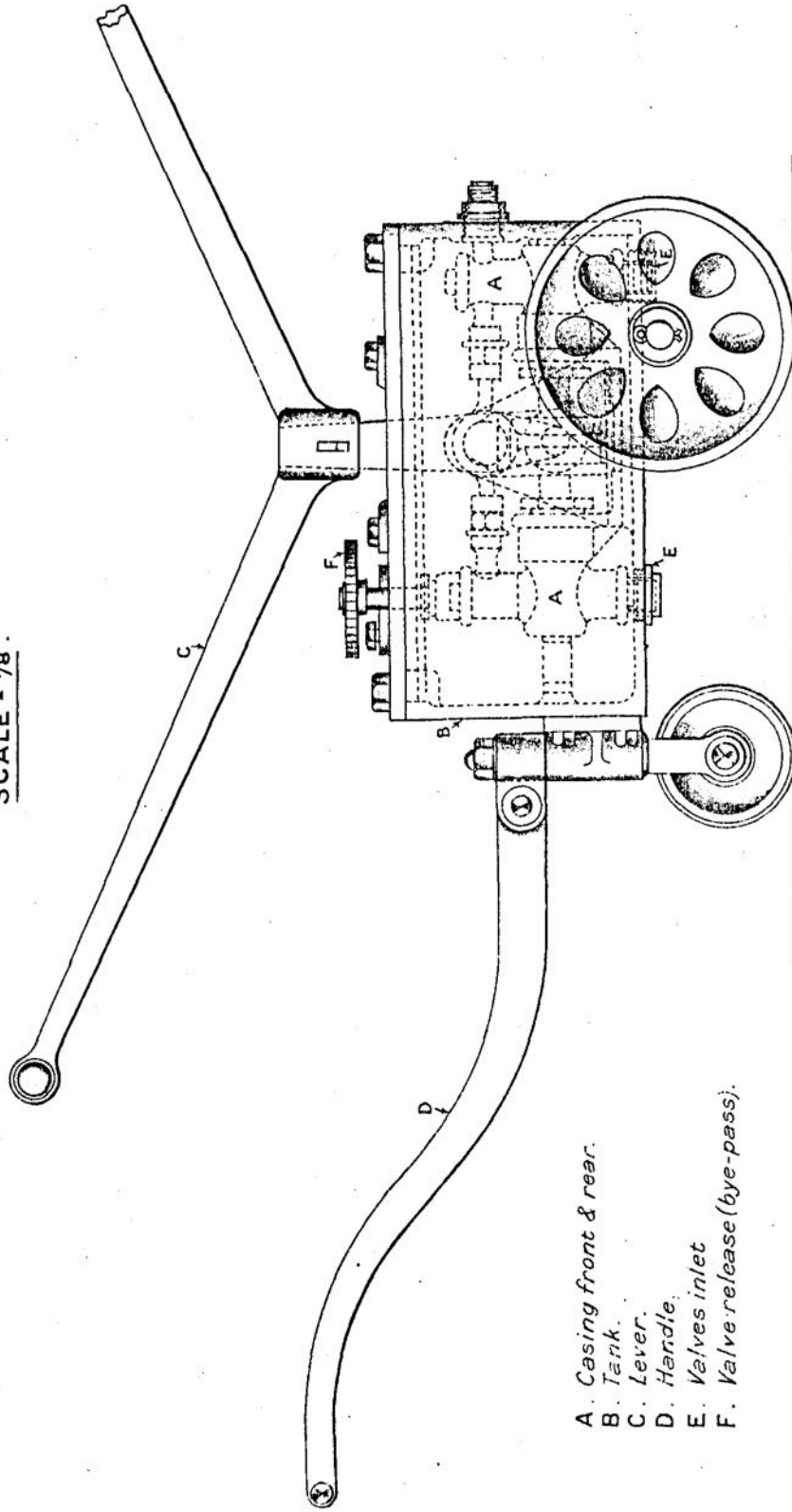


- A. Tank
- B. Plunger, Pump large.
- C. " " small.
- D. " large outer.
- E. Bar, securing plunger.
- F. Seating, plunger, small.
- G. Pin Valve.

- H. Valve, suction.
- J. Seating, intermediate.
- K. Cylinder.
- L. Lever, rocking for socket.
- M. " "
- N. Pipe, discharge.

PUMP, RUNNING BACK, PORTABLE, MARK I.

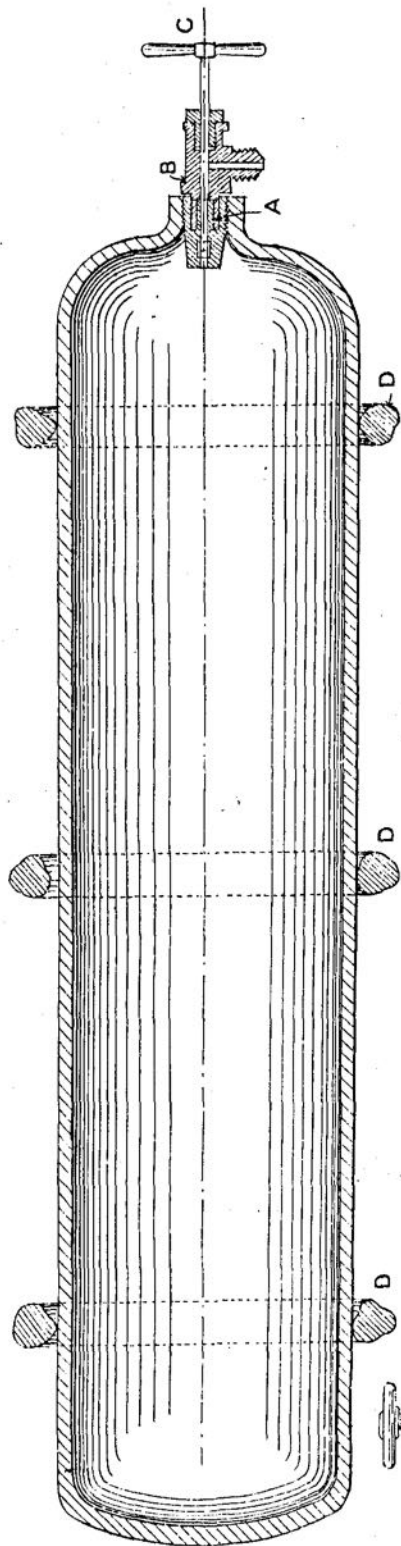
SCALE = 1/8.



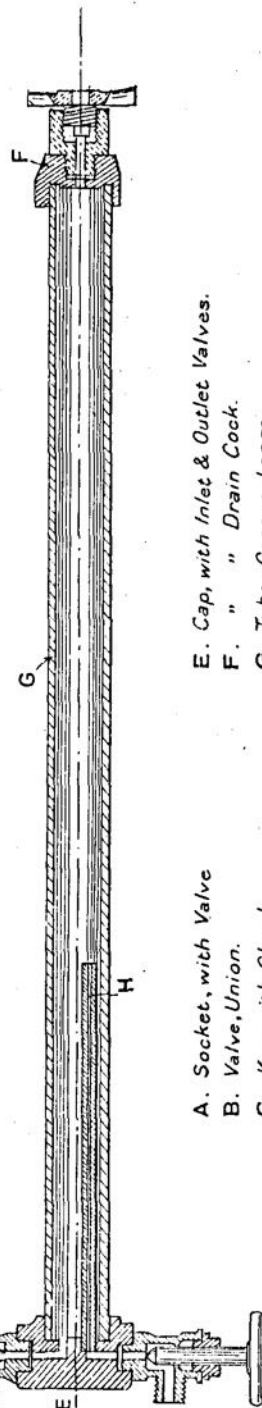
- A. Casing front & rear.
- B. Tank.
- C. Lever.
- D. Handle.
- E. Valves inlet
- F. Valve release (bye-pass).

RESERVOIR, COMPRESSED AIR, MARK II.

SCALE $\frac{1}{6}$.



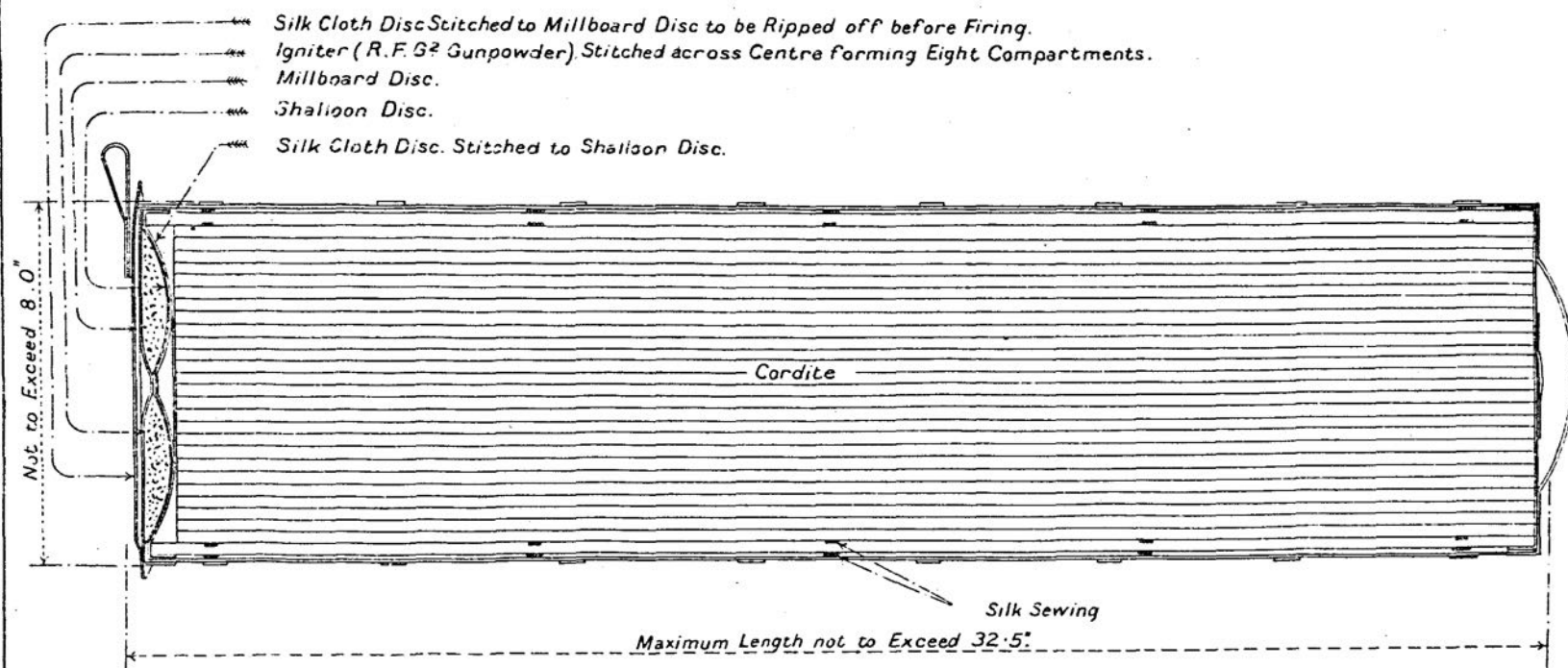
SEPARATOR.



- | | |
|-----------------------|-------------------------------------|
| A. Socket, with Valve | E. Cap, with Inlet & Outlet Valves. |
| B. Valve, Union. | F. " " Drain Cock. |
| C. Key, with Gland. | G. Tube, Copper, Large. |
| D. Grumamets. | H. " " Small. |

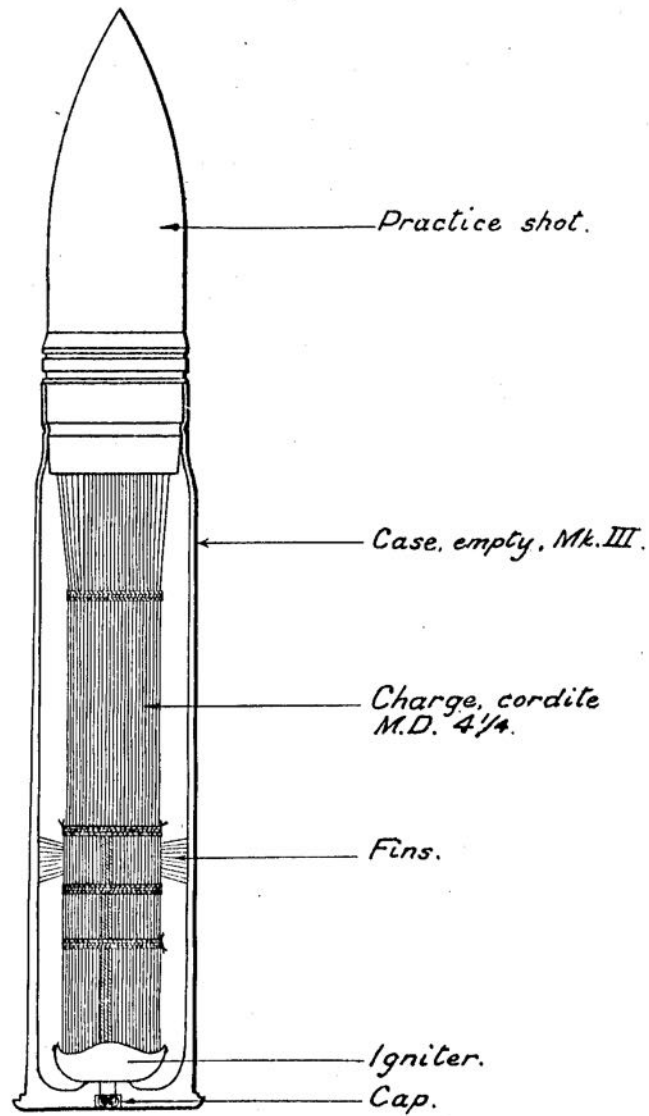
CARTRIDGE, B.L. 9·2-INCH, 60-LB, CORDITE, M.D. 37.

SCALE = $\frac{1}{4}$ APPROX.



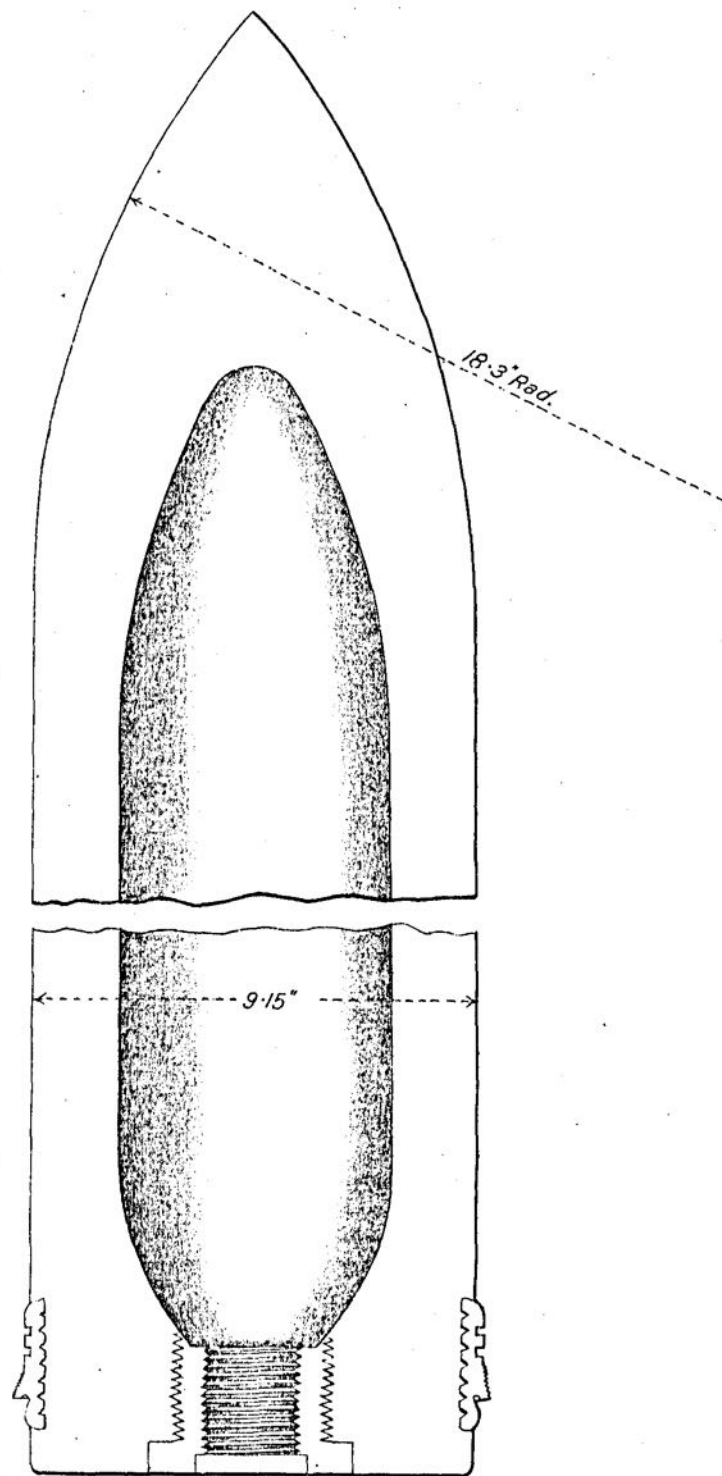
CARTRIDGE, Q.F. 6-P^{ER}. CORDITE, M.D. PRACTICE
AND SUB-CALIBRE, MARK XXV.

Scale = $\frac{7}{16}$.



SHELL, B.L. ARMOUR PIERCING, 9·2-INCH.

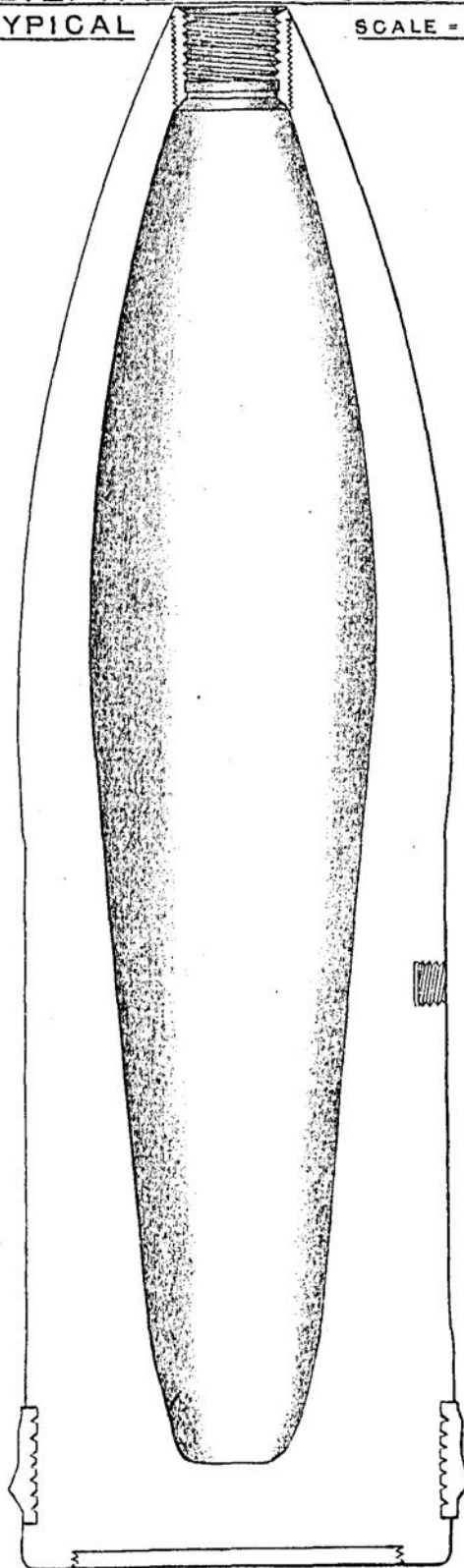
SCALE = $\frac{1}{4}$.



SHELL, B.L. H.E. 9.2 - INCH GUN, HEAVY.

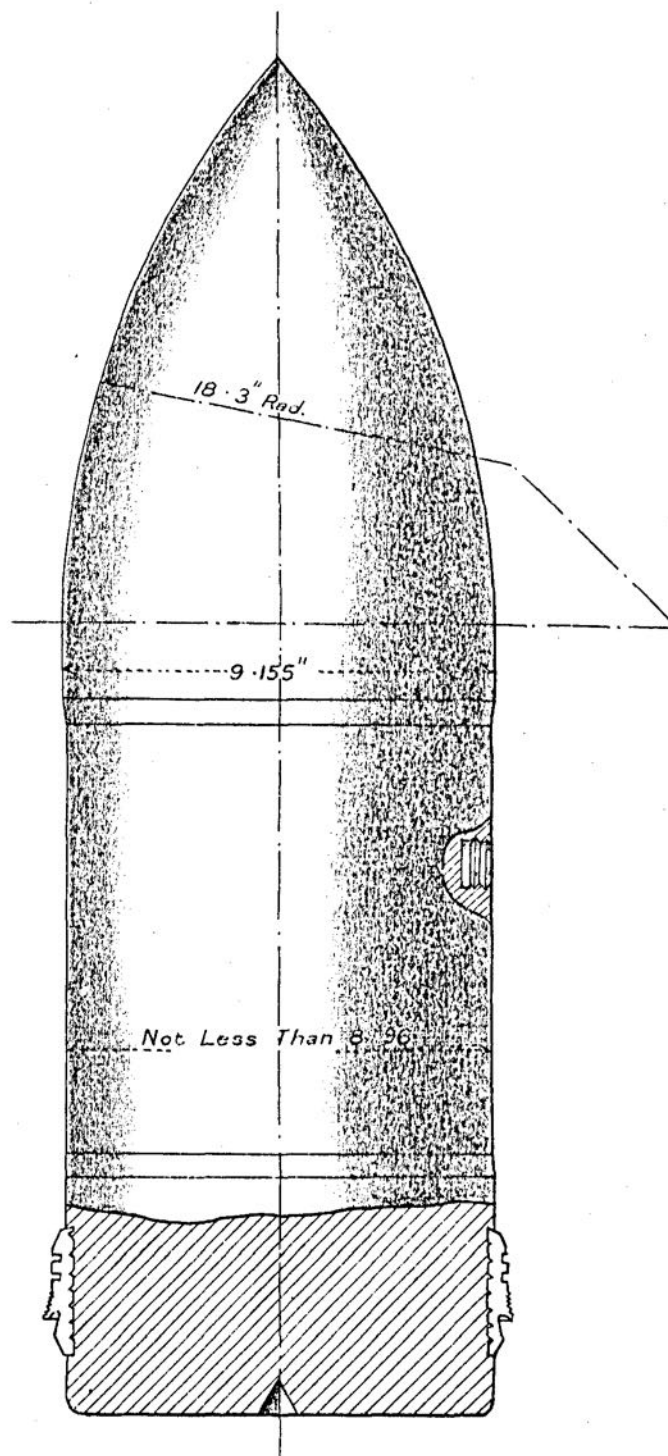
TYPICAL

SCALE = $\frac{1}{4}$.



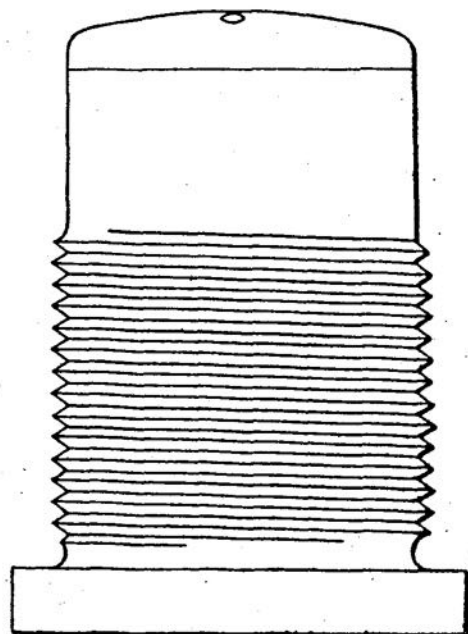
SHOT, PRACTICE. B. L. 9 · 2-INCH, HEAVY.

SCALE - $\frac{1}{4}$.

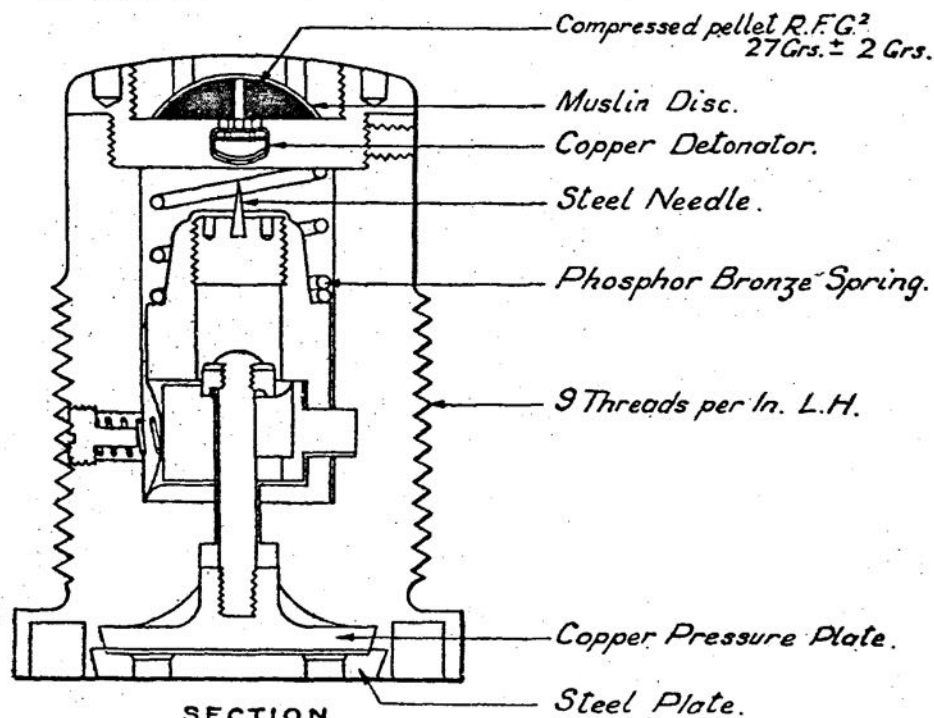


FUZE, PERCUSSION, BASE, LARGE, N^o II, MARK IV.

METAL.
FULL SIZE.



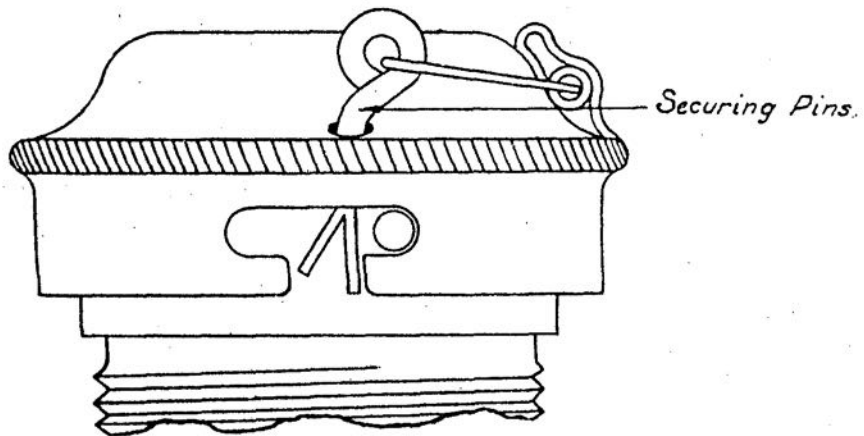
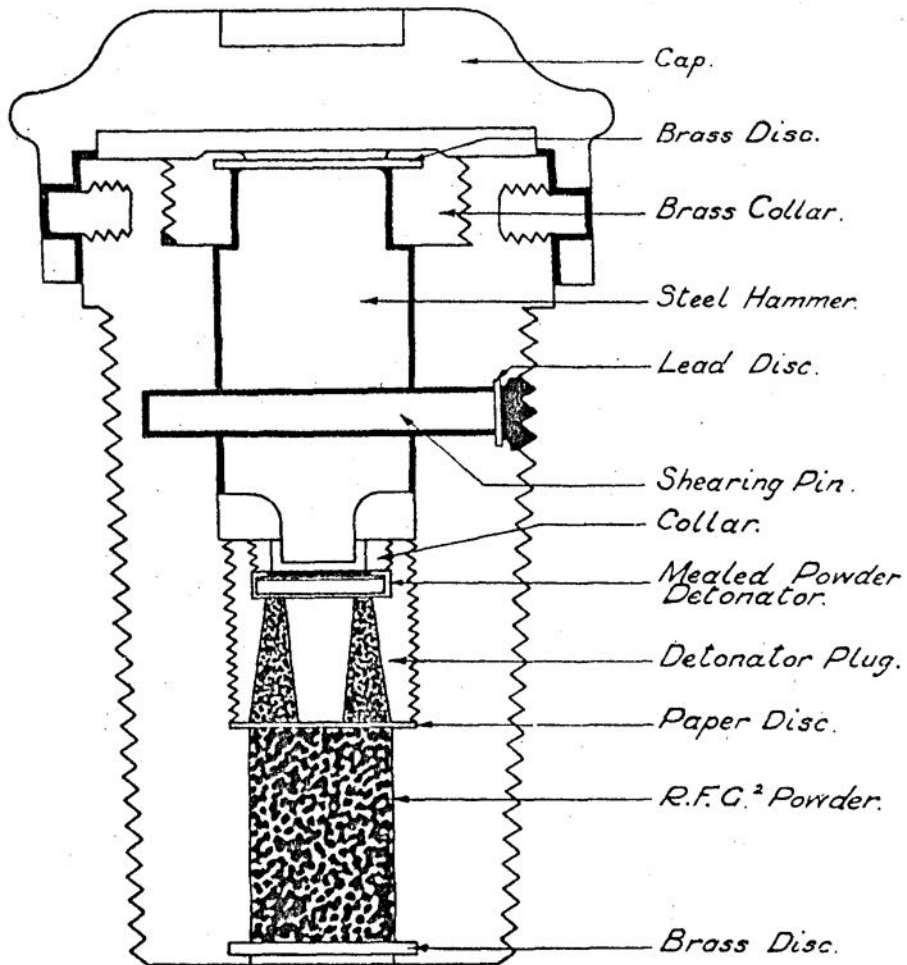
ELEVATION.



SECTION.

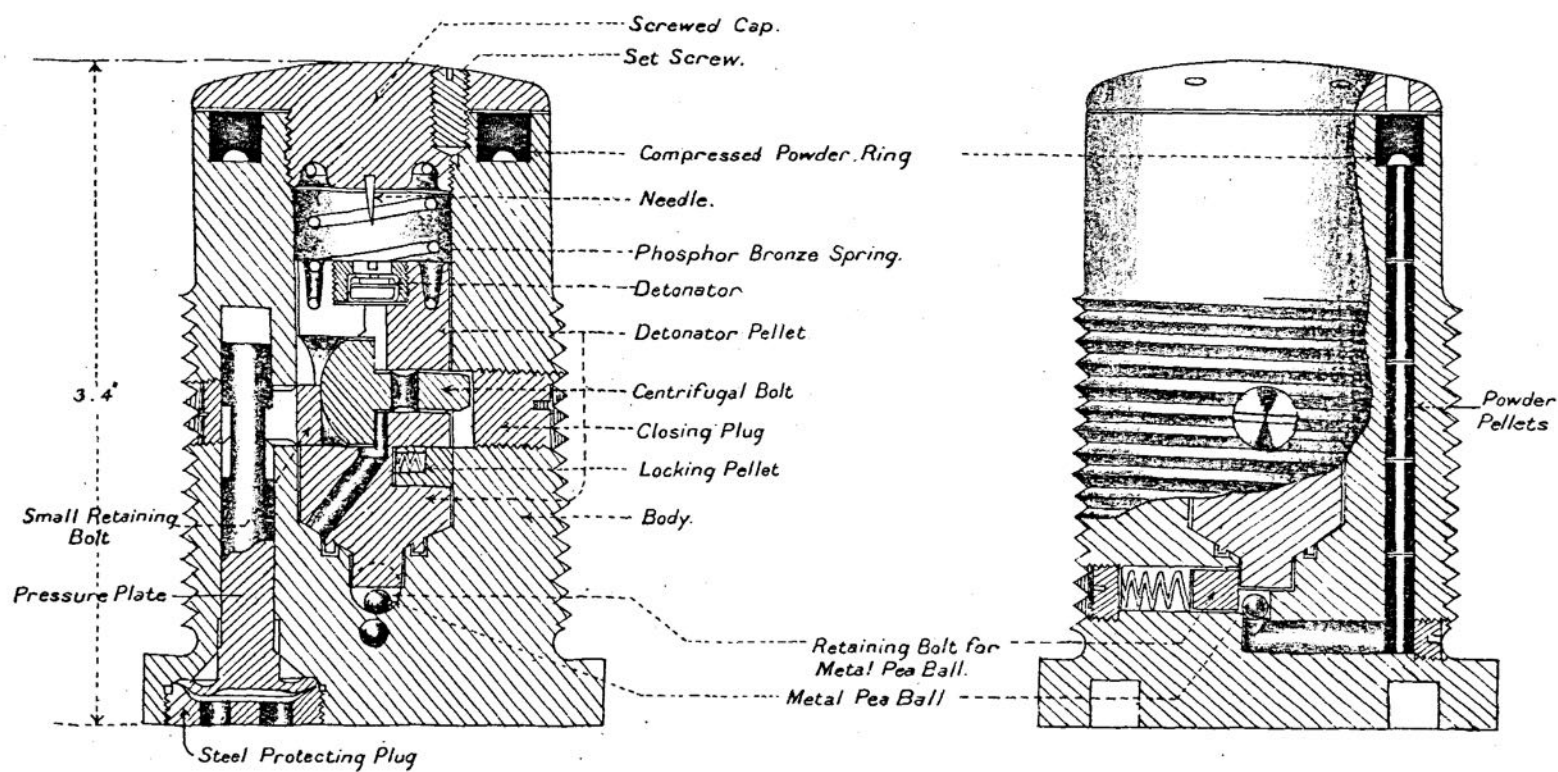
FUZE, PERCUSSION, D.A. IMPACT, N° 13, MARK V.

Scale = $\frac{2}{1}$ approx.



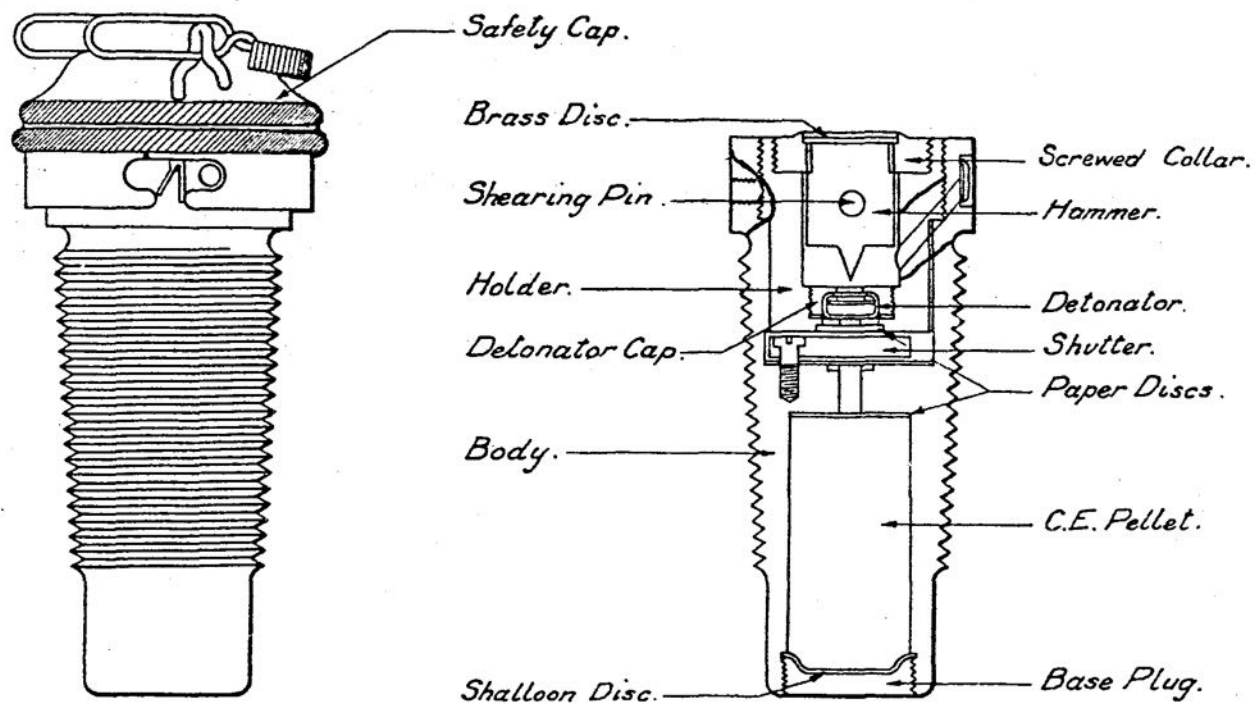
FUZE, PERCUSSION, BASE, LARGE, BRONZE, N° 15.

SCALE $\frac{1}{4}$.



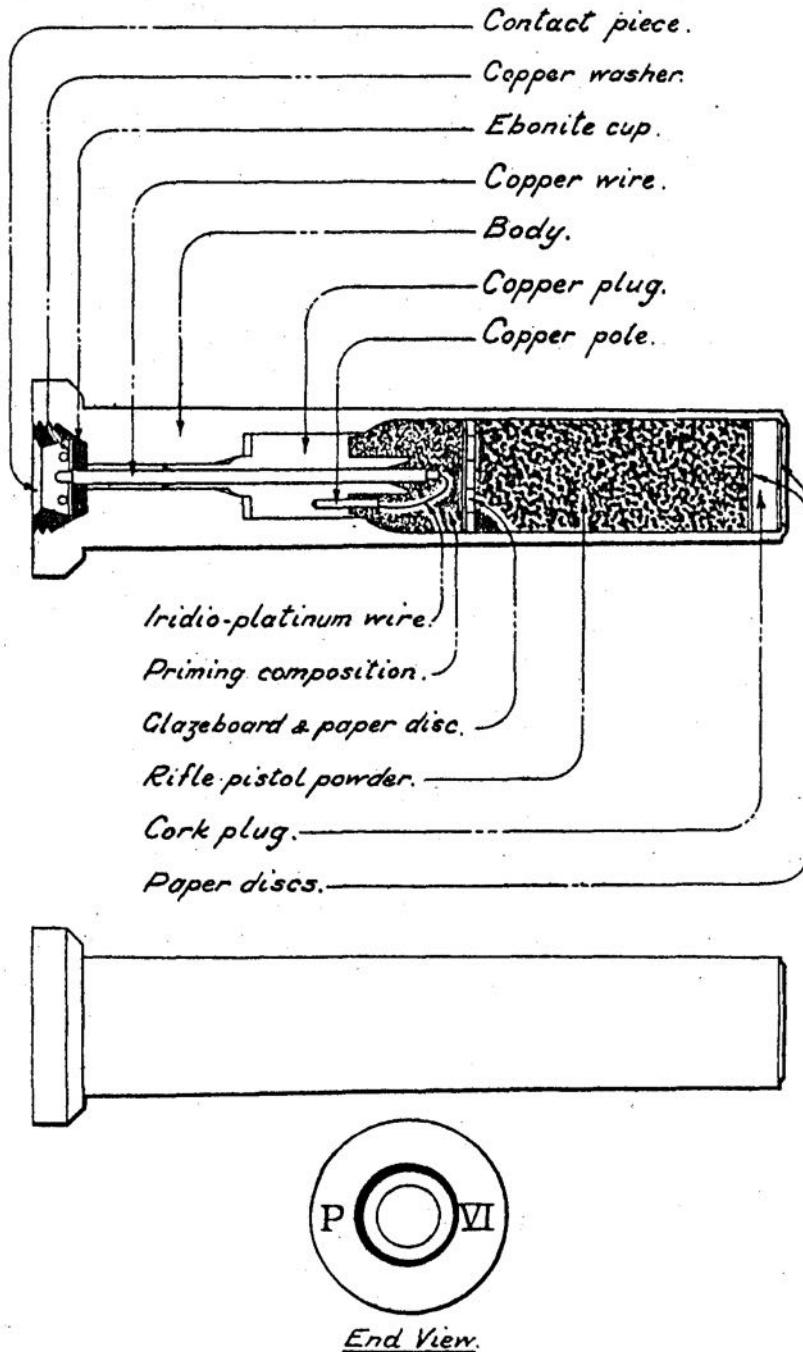
FUZE, PERCUSSION, DIRECT ACTION, IMPACT, N° 45, MARK II.

Scale Full size.



TUBE, VENT SEALING, ELECTRIC, WIRELESS, P, MARK VI

Scale = 2/1 approx.



TUBE, VENT SEALING, PERCUSSION, MARK VII.

SCALE=14/5 APPROX.

